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IMMENSE LOANS FOR MUNICIPAL IMPROVEMENTS at Philadelphia and Cincinnati have been declared legal by the Supreme Courts of Pennsylvania and Ohio, respectively. The Philadelphia loan is for $11,200,000, divided as follows: Improving the water supply, $3,700,000; repaving streets, $2,000,000; free library site and building, $1,000,000; school buildings, $900,000; abolition grade crossings at Trenton Ave., $900,000; new bridges, $600,000; main sewers, $500,000; repairing paved streets, $400,000; miscellaneous, $1,400,000. None of this money is available until appropriated by specific ordinances, most of which have not been passed. The Cincinnati loan is for the new water-works plant, already under construction.

THE VALUE OF THE WATER-WORKS OF LOS Angeles, Cal., or, more strictly, the value of improvements made by the Los Angeles City Water Co. during 30 years to a small plant owned by the city, has been fixed by arbitration at $1,183,591. The arbitrators were Col. G. H. Mendell, Jas. C. Kays and Chas. T. Healey, but the latter dissented from the award on the ground that it was too low. In our issue of May 4 we published some extracts from a report by a board of engineers on the depreciation of the works, and also the estimate of the board on the value of the physical property of the company. The valuation was $995,389, after deducting depreciation and adding interest and contractor's profits. The arbitrators seem to have placed a higher valuation on the plant, besides which they allowed nearly $60,000 on account of its earning value. The latter sum the company declares is so absurdly low as to warrant taking the matter into the courts. The conditions are unusual, since the city originally owned the works and the water rights and was to pay the company for the value of improvements at the end of 30 years. When the term expired the city proposed to take possession of the works on the ground that the company was its tenant; but the courts have held that the agreement was a contract and not a lease.

THE NEW BOSTON SYSTEM OF SEWER ASSESSments has been declared unconstitutional by the State Supreme Court, and all work except maintenance has been ordered stopped. The system was outlined and discussed in our issue of Oct. 13, 1898. Its principal novelty was the placing of three-fourths the cost of maintenance as an assessment on real estate, but with certain allowances in case of previous assessments for construction. In addition, the cost of new construction was to be assessed upon the property benefited thereby. The court decided unanimously that such a plan was illegal, because it was neither a general property tax, nor a special assessment, under the accepted meaning of the law. Fortunately the Massachusetts legislature is in session. An attempt will be made to secure new legislation. Possibly the decision may affect Brockton, which has been following a somewhat similar plan for a few years.

A MUNICIPAL CONGRESS is proposed by the Pan-American Exposition Co. in connection with the Buffalo Fair of 1901. The scheme now is to have a large exhibit illustrating municipal undertakings, including reports, plans, photographs, models and apparatus, in addition to some days devoted to discussions of methods of city government.

DEFECTIVE ASPHALT PAVING is becoming unpleasantly prominent in Chicago. The engineer of the Street Department, Mr. Wheelock, attributes this to the severe winter, while others attribute it to defective material and workmanship as the result of sharp competition and low prices. On 60 miles of streets a general resurfacing is necessary.

OIL TO LAY STREET DUST AT JACKSONVILLE, Fla., is reported as having been bought by the board of public works of that city. It is said that 100 bbls. have been bought from the Standard Oil Co., at $3.55 per bbl. It is estimated that 1 bbl. of oil will spray one mile of shelled street, 30 ft. wide.

RULES FOR AUTOMOBILES and motor carriages have been adopted in France to secure complete safety to passengers, pedestrians and other vehicles. These require that the operating mechanism, steering gear and brakes meet the approval of an inspection board, and are, in brief, that:

Each vehicle must bear the maker's name, the type of machine and the number of vehicle in that type, also the name and address of the owner.

No one may drive the automobile who is not the holder of a certificate of capacity, delivered by the prefect of the department in which he resides and granted with the consent of the Service des Mines.

The driver of an automobile must always have the regulator of the speed well in hand. In case of narrow or crowded thoroughfares, the speed must be reduced to a walking pace, and in no case must it exceed 18½ miles in the open country or 12½ miles an hour upon passing houses.

Racing is allowed, provided authorization is obtained from the prefect and the mayors are warned. In racing a speed of 18½ miles an hour may be exceeded in the open country, but in passing houses the maximum of 12½ miles must not be exceeded.

The approach of the automobile must be signaled by means of a trumpet. Each automobile must be provided with two lamps, one white and the other green.

THE MOST SERIOUS RAILWAY ACCIDENT of the week occurred on the Philadelphia & Reading Ry., near Tamaqua, Pa., on May 16, as the result of a spike placed on the track. This caused a passing train to jump the track and crash into a freight train running in the opposite direction. One man was killed and two others were seriously injured.

A PECULIAR ELEVATED RAILWAY ACCIDENT occurred on the Brooklyn Elevated Ry. on May 23, which shows how a serious accident may result from a trivial first cause. In this case a regular train with its locomotive running rear end foremost was wrecked by a cylinder head blowing off and falling between the track and guard rail in front of the truck of the foremost car. This truck was torn from the car and fell between the tracks to the street, just missing a passing trolley car. No one was seriously injured.

THE STEAMER "PARIS," one of the swift express steamers of the American Line, from Southampton for New York, ran on the submerged rocks near the "Manacles" on May 21. It will be remembered that this is in the English Channel, about two miles off Coverack, England, and is where the "Mohegan" sank. From press reports it appears that for some reason, as yet unknown, the Paris was 10 to 20 miles out of her course, and in the fog which prevailed at the time ran on the rocks. The sea was calm at the time, and as perfect discipline prevailed all passengers were removed to the shore without accident. Tugs and naval vessels were sent to the assistance of the steamer. Immediate efforts to pull the Paris off the rocks proved useless, and it became necessary to remove the cargo and coal. This work has been done, and it is hoped that the vessel may be saved.

THE STEAMER "LA BRETAGNE," of the Compagnie Generale Transatlantique, was badly damaged at her dock, pier 42, New York city, on May 18, by the North German Lloyd steamship "Barbarossa." The latter steamer left Hoboken, N. J., bound for Bremen at 11 a. m., of the same day, but later returned with a fire raging in her forehold. On her way up the North River to the North German Lloyd pier the "Barbarossa" was diverted from her course by the strong flood tide and collided with a scow, the French liner, "La Bretagne" and two ice barges, besides damaging pier 42. The French liner will have to be dry docked. Blame for the accident is stated to rest entirely on the "Barbarossa."

A FIGHT BETWEEN RAILWAY EMPLOYEES, instigated and aided by their superiors, occurred May 14, at Janesville, Wis. The Chicago & Northwestern Ry. on Saturday night secretly laid a new sidetrack on River St., to which the Chicago, Milwaukee & St. Paul Ry. had objected, but for which the city council had granted a right of way. When the latter road discovered the work it blocked its progress by a train of box cars, and the riot ensued when an attempt was made to upset one of the cars on the crossing. The Chicago & Northwestern Ry. forces, under the direction of two division superintendents, broke the blockade by running a train of gravel cars through the other train. Both roads have obtained injunctions and further trouble is feared.

THE REMOVAL OF THE DRAWBRIDGE over the Chicago River at Taylor St., Chicago, was successfully accomplished on May 11. Two scows were floated under the span, and cribbing was built up to the necessary height. The bridge was then jacked up to allow of additional blocking being added to carry it clear of the center pier, and the scows were then towed down the river. A Scherzer rolling-lift, bascule bridge is to be built at this point, in order to give the necessary waterway for the drainage canal, and this bridge will be built by the Trustees of the Drainage Board. They will also build a similar bridge to replace the railway drawbridge just below Taylor St.

ONE OF THE OLDEST BRIDGES IN EUROPE is soon to disappear under the demand for better navigation of the river it spans. This is the stone bridge, with fifteen arches and a total length of 994 ft., built across the Danube at Ratisbon by Duke Henry the Superb in 1135-46. The piers rest on piles protected by stone riprap and heavy ice-breakers; the roadway is very narrow and the footways allow the passage of only one person at a time. Hans Sachs, the poet-shoemaker of Nuremberg, sang its praises as one of the wonders of the builders' art and the strongest bridge in Germany. So far as its stability is concerned, it would probably stand for another 750 years—but it interferes with the passage of steamboats.

A BRIDGE DESIGNER AND INSPECTOR is wanted for service under the State Engineer of New York. The examinations before the Civil Service Commission will be held on June 9 and 10; for blank application address the Secretary of the commission, Albany, N. Y. The position is worth from $1,800 to $2,400 per year. At the same time there will be examinations for the position of heating expert, electrical expert and sanitary expert in the office of the State Architect; salaries, $1,200 to $1,500 per annum.

THE RIO GRANDE DAM has received still another setback. It is projected by the Rio Grande Dam & Irrigation Co., of El Paso, Tex. The dam was to be built across the Rio Grande River at Elephant Butte, N. Mex., and was to be of concrete, 96 ft. high, 300 ft. long on the bottom and 550. ft. long at the top, as described at some length in our issue of July 15, 1897. On complaint from the Government of Mexico that the dam and its uses would interfere with the waters of a navigable stream, a bill was brought at the instance of the United States Government to enjoin the construction of the dam. The lower court decided for the company; but the U. S. Supreme Court has remanded the case for determination of the facts as to whether the dam and the diversion of water by it will substantially diminish the navigability of the stream, and rules that the construction must be prohibited, so far as it effects the navigability of the river.

A HUDSON RIVER TUNNEL is projected by the Manhattan Tunnel Co., which has been incorporated in New York State to build a tunnel from near Canal St., in New York, to the middle of the North River, it being the further intention to continue the tunnel to Jersey City. It is stated that the plans for the work have been prepared by Mr. Frederic M. Lande. All details of the scheme are refused except the general statement that no part of the old Hudson River tunnel work will be employed.

NEW HARBOR DEFENCES for New York will be made necessary by the new ship channel under contract. The old defences, now practically completed, were designed for the old channel, only about one mile away, while the new ship channel would pass just about half way between Sandy Hook and Coney Island, which are about 7 miles apart, and 7½ miles to Rockaway Beach. The U. S. Engineers are now planning new defences, the most important of which will probably be on Romer Shoal, right alongside the new channel. Others will doubtless be located on Norton's Point, or Coney Island, and possibly on Rockaway Beach.

A NEW JERSEY PALISADES COMMISSION has been appointed by Governor Voorhees to suggest some feasible plan for their preservation. The commission is made up of Major S. W. McClave, of Edgewater; Mr. Lynn, of Hackensack; Mr. Hopkins, of Alpine; Miss Cecelia Gaines, of Jersey City, and Miss E. B. Vermylie, of Englewood. Two earlier commissions have failed to accomplish results, and now Major McClave favors the purchase of the Palisades by popular subscription; and if sufficient money can be raised he would propose a monument to Admiral Dewey on the point opposite Grant's Tomb. Meanwhile, the Carpenter Bros., quarrymen, are said to be preparing a 7,000-lb. dynamite "blast," which will probably dislodge another large section of the Palisades.

BLOCK SIGNALING AND INTERLOCKING ON THE CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA RY.

The Chicago, St. Paul, Minneapolis & Omaha Ry. (which forms a part of the Chicago & Northwestern Ry. system) has a length of 1,492 miles, of which 25 miles are double track. Of this length, 510 miles (including the 25 miles of double track) are operated on the block system, as follows:

Kind of block.	Miles. Track. Single.	Double.	Total.
Telegraph block	475	25	500
Automatic block (Hall)	10	..	10
Total	485	25	510

Telegraph Block System.

In the telegraph block system there is a telegraph office at the end of each block, the offices being connected by a wire which is divided into sections by ground switches connected with two 50-ohm sounders and one key at each telegraph office, with two cells of gravity battery per mile. The switch is a one-lever, three-point, telegraph switch. The normal position of the lever is on the ground wire, and it is only moved from this position when it is desired to work the blocks through, thus cutting out one office and working two blocks as one. The effect of this is to prevent orders intended for a certain office from passing beyond it, or leaving it in the wrong direction. Thus the signalman will be sure when he hears his block instrument the business is intended for his office. The block instruments are not to be cut out at the switchboard at any time. The average length of block sections is four miles, and new block sections are being installed as fast as they are found to be necessary.

The signals are of the double-arm semaphore type, Fig. 1, showing a red light for "stop," and a green light for "clear." The running side of the arm is red, with a white stripe. They are operated by levers in the telegraph offices. These signals are used exclusively to control trains on the main track, and not for trains on passing tracks or sidings. Their normal position is "stop." No distant signals are as yet being used with the telegraph block signals.

Before lowering a signal to admit a train into a block the signalman must be sure of four things:

(1) That he has no orders for the train.

(2) That all trains coming toward him from the next block station in advance (for which he is blocking opposing trains) have arrived at his station, and passed out of the block.

(3) That all trains which have departed from his station have arrived at the next station in advance and passed out of the block.

(4) That he has received a response from the next block signal in advance, blocking all opposing trains.

FORM 539.

Chicago, St. Paul, Minneapolis & Omaha Ry. Co.

BLOCK SIGNAL CAUTION CARD.

..... *Block Station* .....

BLOCK SIGNAL IS NOT CLEAR.

PART A. *Conductor and Engineman, Train No.* .....
will proceed cautiously from .....
to .....*expecting to find the last train ahead, No.* .....

PART B. *Block Signal is at* "STOP" *for No.* .....*and No.* .....*to meet (or pass) as per Time Table, or as per Train Order No.* .....

I have NO .....ORDERS *for No.* .....

This caution card does not interfere with nor countermand any general or special rule, instructions or any train orders you may have received.

Time issued ..... *M.*

.....*Signalman.*

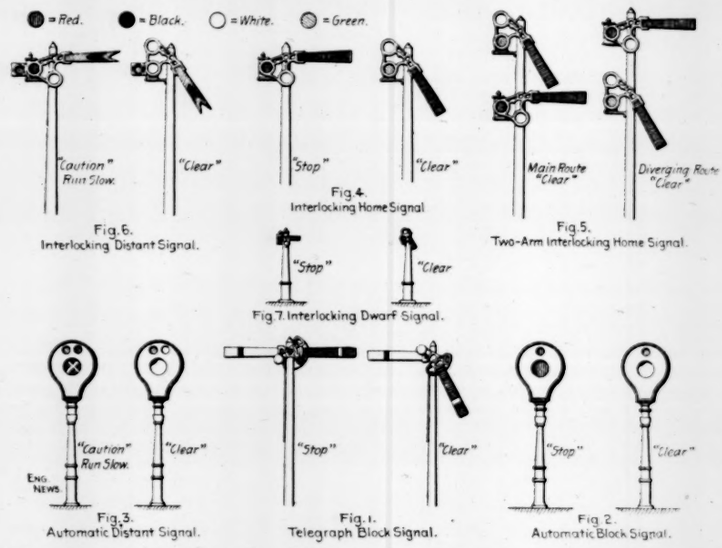
Card No. ..... *To train No.* ..... [O. K.] .....*M.*

.....*Train Dispatcher.*

The above card must be issued as provided in Rule 93, show the name in full of the issuing station, be correctly dated and properly filled out in triplicate, one copy to be delivered to the engineman, one to the conductor and one filed by the signalman. The signalman will enter the conductor's name when the train is special or extra.

A block section is denoted as the main track between two telegraph block stations, but enginemen and trainmen are required to observe yard limits, and limits between the outer approaching switches of the block station towards which they are running.

The signals are of the two-position type, permissive blocking being only allowed on direct orders from the train dispatcher to the signalman, and being governed by the issue of "Caution cards" of the form shown herewith, instead of by a special indication of the signal, as on the Atchison, Topeka & Santa Fe Ry. (Engineering News, March 30). The card is printed on red paper, and is 5 × 8 ins. in size. It will be seen that it has two parts or divisions, the first to give information as to other trains in the block, and the second to take



FORMS OF BLOCK AND INTERLOCKING SIGNALS, CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA RY.

his train is on the siding, clear of the main track, before reporting that such train has cleared the block.

When it is necessary for a train which has been reported as having cleared a block to back into such block, the signalman will proceed the same as in case of an approaching train. A signalman receiving notice of any obstruction in a block must notify the signalman at the other end of that block. A clear signal or release card admitting a train to such block must not be given until the obstruction is removed.

For cases where a train has to pass a signal indicating "stop," the signalman issues a "release card," the form of which is shown below. It is the same size as the "caution card," but printed on green paper. This card, which is only issued in the place of a "release card," thus obviating the necessity of issuing two cards to one train. The card is used for three purposes: (1) to permit a train to follow another into the block; (2) to permit trains to meet at a non-telegraph station between two block signal stations; (3) to be issued at a station where trains are to meet, and the passing track is in advance of the block signal. In cases (1) and (2) the signalman fills in parts (A) and (B) of the card, respectively, under orders from the train dispatcher. In case (3) he fills in part (B) without getting any orders from the dispatcher. At terminal and division stations, however, the card must never be issued except by such order. If train orders are delivered with the card, the signalman fills it in to read "I have no 'further' orders for No. ——."

In permissive blocking, a freight train is not allowed to follow a passenger train into the same block. Occasionally, however, a freight or passenger train is allowed to follow a freight train into the block, in order to avoid delays, when circumstances will permit.

To prevent a train from following another into a block section, before it has a caution card, the signalman in advance must not give the response blocking opposing trains (when there is a train still in the block), until the signalman requesting this response states that he has obtained authority to issue the card.

After a train has been stopped by signal at a block station for orders, the signalman must not accept an order to hold the train or give the response that he has held it, or acknowledge the receipt of a train order for it, until the conductor has been shown the order and has signed it, with the understanding that his train is held.

If a train enters a siding at a block signal station to be met or passed by another train, the signalman must know that it is clear of the main track, and the switch closed, and see the markers or receive a report from the conductor that all of

When it is necessary for a train which has been reported as having cleared a block to back into such block, the signalman will proceed the same as in case of an approaching train. A signalman receiving notice of any obstruction in a block must notify the signalman at the other end of that block. A clear signal or release card admitting a train to such block must not be given until the obstruction is removed.

For cases where a train has to pass a signal indicating "stop," the signalman issues a "release card," the form of which is shown below. It is the same size as the "caution card," but printed on green paper. This card, which is only issued when there is no train or obstruction in the block ahead, serves three conditions:

(1) To release a train when the signal has been displayed to block a train until all trains (in both directions) in the block have cleared the block, or until any obstruction has been removed.

(2) To release a train after train orders have been delivered to it, the signalman filling it in to read "I have no 'further' orders for No. ——."

(3) To release a train when the signal is improperly displayed, or is not changed in time to avoid stopping the train. The signalman then fills in a statement under "Remarks," as "Signal displayed in error."

A train standing on the main track at a station, and having the right to pass into the next block, should advance when possible, so that the last car will be 300 ft. beyond the signal, to admit of the block in the rear being cleared.

A train having cleared a block must not back into nor within 300 ft. of such block without the permission of the signalman.

On double track, when it is necessary for a train to cross to the opposite track, the conductor must

FORM 538.

Chicago, St. Paul, Minneapolis & Omaha Railway Co.

BLOCK SIGNAL RELEASE CARD.

..... *Block Station* .....

REMARKS:

I have NO .....ORDERS *for No.* .....

This release card does not interfere with nor countermand any general or special rule, instructions or any train orders you may have received.

Time issued .....*M.*

.....*Signalman.*

INSTRUCTIONS.—This form to be used at all block signal offices, as provided in Rule 97, to show the name in full of the issuing station, to be correctly dated and issued in triplicate, one copy to the engineman, one to the conductor and one filed by the signalman. **The conductor must see that the number of his train is entered in the above form correctly.** The signalman will enter the conductor's name when the train is special or extra.

first notify the signalman at the block station where the crossover is located, who then applies to the train dispatcher for authority to issue a "crossover permit." Before issuing it to the engineman and conductor, however, he must obtain a response from the next signalman in advance, to the effect that all opposing trains are blocked. When the train is again on its proper track, the dispatcher is informed, and then cancels the permit in the same way that train orders are cancelled.

Automatic Signals.

The automatic block signals are of the Hall disk or banjo type, and are used where there are a number of tracks, and on curves. The distance between them varies with the conditions, and with the curves. The regular block signal, Fig. 2, shows a red disk or light for "stop," while the absence of the disk (or a green light) indicates "clear." At certain points distant signals are used, Fig. 3. These show a green disk with white cross or a red and a green light (in conformity with the Chicago & Northwestern Ry. practice) for "caution" and the absence of the disk (or a single green light) indicates "clear." Rail and line circuits are used, gravity batteries furnishing current for the former, and Edison-Lalande batteries for the latter.

The normal position of the signals is at "clear," and the operating points are located and arranged so that two opposing trains cannot enter the same block at the same time. A train stopped by a "stop" signal, or leaving part of the train in one block to do work in the next block, must send out flagmen in the usual way.

A train finding an automatic block signal at the "stop" position must come to a full stop before reaching it, and then proceed under protection of the proper red signal, expecting to find the block occupied, an open switch, or a broken rail, until it arrives at a clear signal.

Both ends of the crossovers connected with the main track are connected with the signal circuit, and will cause the first and second signal on each side of the switch to indicate "stop," when either switch has been opened.

Indicators are located at each siding switch in the main track, and at each crossover switch in a foreign track connection within the limits of the automatic block signal system, and will disclose a small red disk, indicating that a train is approaching the switch along the main line track in either direction. If the indicator does not show a red disk after a switch has been opened, it signifies that the signal has failed to go to "stop." In such case movements must be made under protection of flag.

A train allowing another to pass it must not come out on the main track until the train which has passed shall have reached the next signal, or had ample time to do so; but shall open the switch leading to the main track in order to keep the signal back of the switch at "stop" for its own protection.

Enginemen must not allow either firebox or front end cinders to be dropped on the main tracks between signals.

Interlocking Plants.

This road, with 1,492 miles of railway, has about ten interlocking plants, all of which are at junctions. The signals are of the semaphore type. The home signals have either one or two blades, as in Figs. 4 and 5, painted red on the running side, and show a red light for "stop" and a green light for "clear." Where two blades are used, the upper one governs the main route, and the lower one governs the diverging route. At junction points the arms are arbitrarily assigned to the routes they will govern. The distant signals, Fig. 6, have forked ends, and the blades are painted green, with a red stripe, a combination which makes a rather inconspicuous signal when the colors have become a little weatherbeaten. A double-light lamp is used, and at night the signal shows a red and a green light side by side for "caution," and a single green light for "clear." This style of distant signal is that of the Chicago & Northwestern Ry.

At crossings the distant signal is about 1,500 ft. from the crossing; the home signal, 350 ft.; and the derailing switch, 300 ft. The signals are of high or low pattern, according to local conditions, and the arms may be on single posts, bracket posts, or on bridges over the tracks. In the latter case, they are placed directly over the tracks which they govern.

Dwarf signals, Fig. 7, with small semaphore arms on posts not over 5 ft. high, are used at interlocking points to govern the movements of trains, (1) on sidings, (2) from siding to siding, (3) from siding to main track, (4) on crossover track, and (5) back-up movements, or trains moving in the wrong direction on main track. These signals have red arms, and show red and green lights, the same as the home signals.

Trains or engines may run to, but not beyond, signals indicating "stop." At crossings, the speed must not exceed 20 miles per hour from the distant signal to and over the crossing.

The telegraph block signals and equipment on the Eastern Division, between St. Paul and Elroy, are of the National (now the Union) Switch & Signal Co.'s make. On the Western Division, between St. Paul and Sioux City, the Sanborn rail-post signal is used. All the erection was done by the railway company.

In the Sanborn signal, above referred to, and which is shown in Fig. 8, the post is built up of two old track rails, riveted together for a height of 15 ft. 1½ ins. above the ground, and then spread apart, making room for the balance levers and the lamp bracket. It will be noted that the lamp is in the middle of the post. For drawings of this signal, we are indebted to Mr. S. Sanborn, General Superintendent of the Chicago & Northwestern Ry., by whom it was patented in 1895. It is extensively used on this road, and the last lot of these signals made at the railway company's shops at Chicago cost $31.29 each, including blades, rods, and everything complete.

The automatic block signals were put in by the Hall Signal Co., of New York, N. Y. The interlocking plants were installed by the Union and National signal companies, which have now been consolidated under the name of the Union Switch & Signal Co.

Special care is taken to insure that station agents, operators, enginemen and trainmen know and understand the rules and regulations under which the block system is worked, and forms with questions on the subject are issued to these employees as a guide to enable them to become prepared for the examinations which they have to undergo at certain times.

The information given in this article is compiled partly from a paper on "The Telegraph Block System," read by Mr. H. C. Hope, at the annual meeting of the Railway Telegraph Superintendents' Association, at Omaha, in 1898, and partly from the new book of rules and regulations prepared under the direction of Mr. J. C. Stuart, General Superintendent; Mr. H. C. Hope, Superintendent of Telegraph and Signals; and Mr. W. H. Scott, General Manager, of the Chicago, St. Paul, Minneapolis & Omaha Ry.

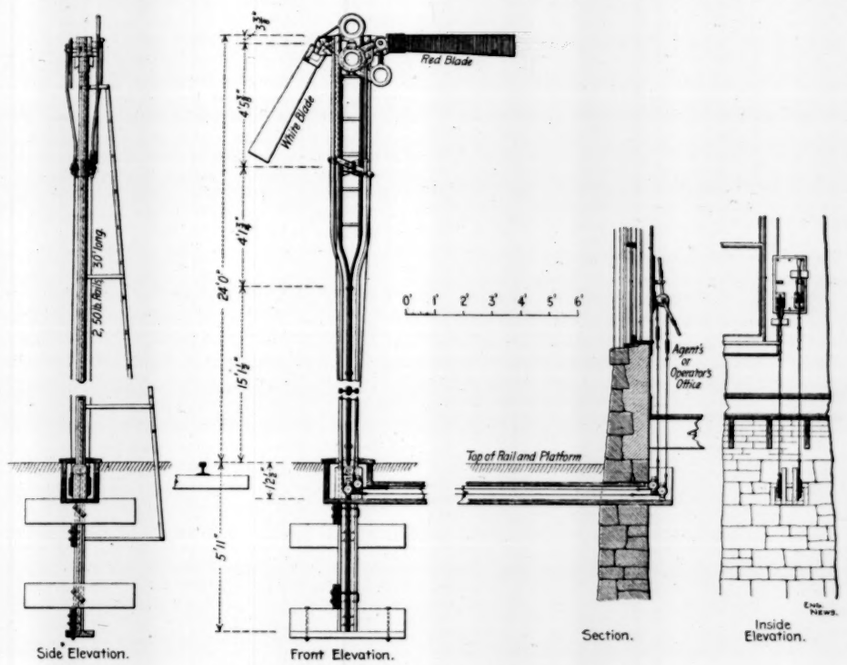


FIG. 8.—THE SANBORN RAIL-POST SIGNAL.
S. Sanborn, Gen. Supt., C. & N. W. Ry., Patentee.

THE ALEXANDER III. BRIDGE, PARIS; CONSTRUCTION AND ERECTION OF ARCH RIBS.

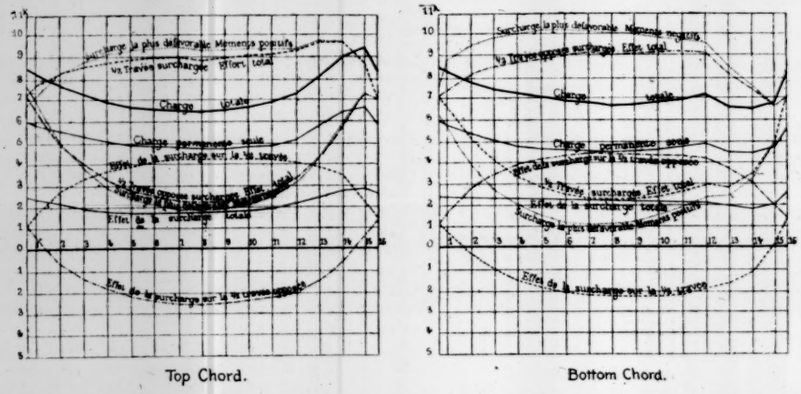
(With two-page plate.)

In our issue of April 21, 1898, we published the general elevation and dimensions of the new cast steel arch bridge of "Alexander III.," now being constructed to unite the Champs Elysees and the Esplanade des Invalides, across the River Seine, at Paris, France, and at the same time gave the foundation work, in full detail. From recent articles in the "Annales des Ponts et Chaussees" we abstract the following description of the construction and erection of the arch ribs. This part of the work is particularly novel in the use of arch ribs made up of solid cast steel voussoirs, and also in the erection of the ribs on a centering which was suspended from an overhead span or traveler in order to leave the stream unobstructed for navigation. Several reasons led to the use of cast steel for the arch ribs. It was necessary, first, that at least 50 m. (164 ft.) at the center of the stream should not be obstructed by falsework centers of the ordinary kind, which would have been practically necessary had the ribs been riveted work. The lighter cast ribs, made up of a number of separate voussoirs, could be erected without such a permanent centering on account of the rapidity with which they could be assembled by the bolted joints. It was also recognized that the cast metal would resist corrosion better than wrought steel, and that bolted joints and cast steel were also perfectly suitable for use in a member subjected to compression only. These were considered by the engineers to be important advantages and, while the possible difficulty of being able to secure perfect castings was recognized, it was believed that by exercising proper care it could be avoided.

The Alexander III. Bridge is a three-hinged arch with a span of 107.5 m. (352.6 ft.), c. to c. of end

pins, and a width of 40 m. (131.2 ft.), divided into a roadway of 20 m. (65.6 ft.) wide, and two side walks each 10 m. (32.8 ft.) wide. The arch ribs are 15 in number, spaced equal distances apart, and, as already stated, are made of voussoir-shaped steel castings bolted together to form a continuous rib.

Considerable study was given to the form of arch rib to be adopted in order to have it obey theory, and at the same time conform to the practical requirements of the foundry. For aesthetic reasons the two outside ribs were made different from the 13 intermediate ribs. In elevation this difference was but slight, but the section in one case was made channel-shaped, and in the other case it was made I-shaped. Considering first the outside ribs in elevation, they have a depth of 1 m. (3.28 ft.), at the hinges, and of 0.95 m. (3.12 ft.) at the crown. This depth gradually increases at the haunches to something over 1.5 m. (about 5 ft.). The hinges are placed exactly at the center line at both the abutments and crown. For the interior ribs, as shown by Fig. 1, the depth at the crown was decreased to 0.85 m. (2.79 ft.), the hinge at the crown was located slightly above the center line, and the curve of the extrados was flattened slightly. Each half arch rib for both exterior and interior arches is made up of 16 voussoirs and a pedestal or shoe. The end voussoirs are designed to carry the pins, and are somewhat complex in shape, but the others are simple forms of either I-beam or channel section.



Top Chord. Bottom Chord.

FIG. 7.—DIAGRAMS SHOWING STRESSES IN ARCH RIB UNDER DIFFERENT CONDITIONS OF LOADING.

Intermediate Ribs.—As already stated, Fig. 1 is a general elevation and plan of one-half of one of the intermediate arch ribs. Fig. 2 is an enlarged elevation and section of one of the ordinary voussoirs. As will be seen, they are flanged on all four sides, and the flanges at the ends are provided with bolt holes for fastening the different voussoirs together. Cast brackets and fins stiffen the flanges against the webs. The joint flanges do not present a plain surface, but are recessed to form projecting ribs, as shown by the end elevation in Fig. 2. The top and bottom and center ribs, which form together an I-shaped rib, bear against each other on adjacent voussoirs, but the side ribs are separted by a space of 2 mm. The bearing surface is planed and polished, if necessary, to secure perfect contact. This form of contact permitted, among other things, the adjustment of slight variations in the castings. The connecting bolts are 35 mm. (1.4-in.) in diameter. Two of them were made a tight fit to aid in adjusting the voussoir, but the others have a play of 0.05 mm. (0.02-in.).

Figs. 3 and 4 show the special voussoirs at the abutments and crown, which receive the pins and constitute the hinges of the rib. These are simply modifications of the regular voussoirs to suit the special conditions. Fig. 5 gives the details of the shoes which convey the thrust of the arch to the abutments. To adjust variations in the length of the arch ribs resulting from errors of any sort, the first joint on each side of the crown was designed so that a wedge could be inserted. This construction and some other details of the voussoirs, joints and shoes, are shown by Fig. 6, which is a section along the neutral axis or center line of the arch rib.

The calculations for the intermediate arch ribs were very elaborate. The load assumed in making the calculations was 400 kgs. per sq. m. (81.8 lbs. per sq. ft.), and a dead load of 150.98 tonnes. The calculation was made first for the dead load only, second for the live load distributed at five points on the arch, and, finally, for the live load placed in the most unfavorable manner. The dimensions of the ribs were established on the basis that under no circumstances was there to be tension, and, that the stress per square centimeter should be less than 10 kgs. under the most unfavorable conditions of loading. The actual stresses at the different sections of the ribs caused by the loads assumed are shown by Fig. 7. The effect upon the magnitude of these stresses due to changes in temperature and to wind pressure was found to be so small that it could be neglected. The total pressure upon each pin of the abutment hinge was found to be 909,027 kgs. These pins are 0.2 m. (7.87 ins.) in diameter, and 0.8 m. (2.62 ft.) long. The arch ribs were given a camber of 0.26 m. (10.23 ins.).

Exterior Arch Ribs.—For aesthetic reasons the I-section was abandoned for the exterior arch ribs, which were made of channel section with the legs of the channel projecting inward toward the center line of the bridge. One of the ordinary voussoirs is shown by Fig. 8, in section and elevation. As in the intermediate ribs, 32 voussoirs are employed. Figs. 9 and 10 show the construction of the hinge voussoirs at the crown and abutments, and Fig. 11 gives details of the bearing shoes or pedestals. A section of the rib along the neutral axis is shown by Fig. 12.

Material.—The quality of the cast steel required and the tests which it should be required to withstand were carefully specified. It was considered that resistance to tension and to shock should be the principal qualities to be required. In tension the strength required should, it was considered, be normally 45 kgs. per sq. mm. (64,004 lbs. per sq. in.), with 12% elongation on test pieces made from bars 100 mm. (4 ins.) long, turned to a diameter of 13.8 mm. (0.552-in.); the limit of elasticity should not be less than 24 kgs. per sq. mm. (34,135 lbs. per sq. in.). It was also considered that these figures should not be rigidly insisted upon, and that a metal a little harder or softer could be permitted, providing it was well manufactured and homogeneous. With this view, a reduction of tensile strength to 42 kgs. per sq. mm. (59,737 lbs. per sq. in.), and a reduction of the elastic limit to 22 kgs. per sq. mm. (31,291 lbs. per sq. in.), was permitted on condition that the elongation did not fall below 15%. An increase in tensile strength to 48 kgs. per sq. mm. (68,271 lbs. per sq. in.) was likewise allowed providing the elongation did not fall below 10%. These allowable variations facilitated considerably the manufacture of the steel castings without compromising in any way the stability of the arch ribs.

The tests for resistance to shock or impact were made upon rectangular pieces, 30 × 30 × 20 mm. (1.2 × 1.2 × 0.8 ins.), which were required to withstand, without rupture, the blows of a hammer weighing 18 kgs. (39.6 lbs.), beginning with a fall of 1 m. (3.28 ft.) and increasing by 0.05 m. (1.98 ins.), until the fall is 1.5 m. (4.92 ft.). The object of this test was to determine the resilience of the metal.

These requirements for the cast steel of the arches were not deemed high enough for the metal used for the bolts connecting the voussoirs or for the pins at the hinges. For the bolt metal the elongation required was 28%, and the tensile strength, 38 kgs. per sq. mm. (54,048 lbs. per sq. in.), with a maximum allowable variation from these figures of 2%. For the hinge pins oil tempered gun steel was used having the following qualities: Ultimate tensile strength, 60 kgs. per sq. mm. (85,339 lbs. per sq. in.); elastic limit, 40 kgs. per sq. mm. (56,893 lbs. per sq. in.); and minimum percentage of elongation, 18%. The impact tests required a cube 3 × 3 c. m. (1.2 × 1.2 ins.) square to withstand 15 blows from an 18-kg. hammer falling 2.75 m. (9.02 ft.).

Erection.—The reasons for erecting the arch ribs by means of a centering suspended from an overhead traveling span have been referred to. This span is shown in plan and elevation by Fig. 13. As will be seen, fixed or permanent falseworks were carried out from each abutment toward the center of the stream as far as could be done, and still leave the required clear opening of 50 m. (164 ft.) at the center. The suspended centering, therefore, extends only over this 50 m. opening. The traveling span is, however, 120 m. (393.6 ft.) long, and is carried by towers mounted on wheels, and, when loaded, also by two intermediate supports resting on the fixed falseworks, as shown by Fig. 13. The span thus has two supports, or four supports, according as it is unloaded, or is loaded, by the suspended centers carrying the arch ribs. Figs. 14 and 15 are transverse sections of the span at two different points. Fig. 14 shows the nature of the cross framing for the end sections of the span between the end and intermediate supports. This framing is repeated at every vertical post. The location of the trolleys and the method of handling the cast steel voussoirs by them is also indicated by Fig. 14, and further by Figs. 13 and 15. Fig. 15 shows the cross framing for the center section of the span, with the centers attached ready for the erection of the arch. The movement of the span, it will be seen, is transversely across the bridge site, and its width between trusses is great enough to allow two arch ribs to be erected without a change of position.

The span was erected on shore and pushed into position endwise in three sections, a pilot truss being added to the end and a temporary floating pier being placed at the center of the river to facilitate the operations. The reason for making three separate operations of the launching, was that the available area for erection was too limited to permit the entire span to be erected at once, and after one section was built it had to be shoved ahead to get room for erecting another section. The erection of the span was begun July 22, 1898, the first third was launched on Aug. 20, and the final third on Sept. 30, 1898.

In closing it may be noted that the superstructure above the arch ribs will be of wrought steel, the arch construction proper being the only place in which cast steel is employed. Fig. 1 shows the points at which the vertical posts carrying the roadway are attached to the arch ribs. These arch ribs, it should also be noted, have no bracing which connects one with another.

REPORT OF A COMMITTEE OF THE WESTERN RAILWAY CLUB ON M. C. B. COUPLERS.

As our readers will recall, we have several times pointed out in these columns the great trouble and expense to which railway companies are now put by the great variety of M. C. B. couplers in use. While all couplers on the M. C. B. lines will couple with each other, there is just enough difference between the different makes to prevent interchangability in making repairs.

A report on this subject was presented by a special committee at the last meeting of the Western Ry. Club, and we print it (omitting the drawings, which accompanied it), as follows:

In a paper presented by Mr. Peter H. Peck to the Western Railway Club at the October, 1898, meeting, entitled "The Adoption of a Standard Knuckle" (Eng. News, Nov. 10, 1898), attention was drawn to the enormous expense to the railways of this country, arising from the multiplicity of the M. C. B. couplers and to the necessity entailed on railways of keeping a large supply of extra knuckles on hand for emergencies or repairs, indicating clearly the great desirability, either of having fewer couplers or an interchangeable knuckle. Mr. Peck recognized that to adopt a uniform or interchangeable knuckle was impracticable, and that to specify the use of a uniform or standard knuckle was tantamount to requiring the adoption of a uniform or standard coupler. Your committee regard any such attempt, however desirable, as wholly impossible, and look for an improvement in the present mixed conditions through the operation of the law of evolution, which shall, as time goes on, weed out the weak and objectionable and allow the fittest to survive. Indeed, there is strong evidence that this is already taking place.

Your committee further believes that this process of evolution can be hastened by an intelligent investigation of the situation; by specifications requiring accuracy of contour lines and good material; and by careful records of coupler failures in service. As has been already pointed out in our discussions of this matter, M. C. B. couplers have heretofore been regarded as of sufficiently equal merit to allow the matter of choice, at least with many railways, to depend largely, if not wholly, on the price quoted.

There have been in use on railways of the United States upwards of 100 different M. C. B. couplers. Of this number certainly not more than 10 or 12 are likely to remain standard couplers long. The other 90 must fall by the wayside for defects which have developed in service.

From the mass of suggestions and information which your committee has received, it offers the following general recommendations:

1. Railway companies should purchase couplers on specifications requiring:

(A) Accurate agreement with M. C. B. contour lines. By this is meant, not simply that the limit gage may be introduced, but that the lines of the coupler shall coincide with the M. C. B. lines when referred to the center lines of the shank produced.

(B) Couplers must be made to withstand shock, and a fair proportion of all purchased should be tested under a drop test.

(C) Couplers must be strong in tension and a proportion of them should be tested under tension.

2. It is thought by your committee that the length of guard arm should be specified by carrying the M. C. B. contour lines about ¾-in. further than at present, modifying the present M. C. B. limit gage. There would be a further improvement if the radius of the curve at the point of the guard arm was specified to be not less than 3-16-in.

3. Your committee wishes to dwell upon the importance of service records of couplers and feels that there is nothing that will so soon point out the defects in apparently meritorious devices. At the present time, there are no good records of the comparative wear of couplers, and this important feature of the question can only be determined by the most accurate service records. The interchange of cars makes the defect of every coupler a matter of concern to every railway company. No company can afford to neglect this question, simply because it is itself purchasing a satisfactory coupler.

4. The question of the location of the pivot pin hole and suggestions looking to greater accuracy in forming this hole, so as to avoid much lost motion is certainly an important consideration, but your committee is not prepared at this time to offer a recommendation upon it.

5. Your committee is impressed with the necessity of a positive locking device, one which will not allow the locking pin or block to "jump" or "crawl" and so permit cars to become uncoupled. Notwithstanding this, however, your committee has no recommendation to make, except to state that no such device, however meritorious it may seem, should be adopted until after a very thorough service test. It has already been proved that some of these apparently "positive locks" have proved worse than useless, and, in some cases even very objectionable.

6. The method of uncoupling is one which deserves consideration and which is susceptible of improvement. There can be no question but that "break-in-twos" have frequently occurred in service from the uncoupling devices now in use. The most familiar way of lifting the locking pin or lock block is by a chain and tumbling shaft fastened to the end sill or deadwood. In case the coupler drawbar pulls out beyond a certain point, the pin or lock block is raised or withdrawn and the car becomes uncoupled. That there are other objections to at least some of the devices designed to take the place of the chain and tumbling shaft are admitted, and your committee does not feel prepared to make any recommendations on this point, further than to call attention to its importance.

7. Some couplers are furnished with what is called a lock-set. This is a very desirable thing in switching cars, and we might say essential to the perfect coupler, yet it should be borne in mind that in adding any complication to the coupler there should be a very careful investigation of its operation in service. The criticism which has been made that M. C. B. couplers, instead of being automatic couplers, are automatic un-couplers, has arisen almost entirely from the defects introduced by attempting to devise a satisfactory lock-set.

8. On the general question of M. C. B. couplers, your committee desires to put itself on record as believing that the lines of the M. C. B. committee will prove entirely satisfactory, and that there is no necessity for a divergence from them. As already stated, the length of the guard arm should be produced somewhat and the relation of the contour lines to the center line of the shank should be adhered to strictly.

Your committee understands that the Committee of the M. C. B. Association has already designed a gage which can be slipped over the shank of the coupler, and so fix absolutely the relation of the center line of shank to the contour line, as contemplated in the M. C. B. lines as shown in Fig. 2, and your committee urges very strongly that such a gage be adopted.

In the main, there can be no question but that the M. C. B. coupler has proved immensely superior to the link and pin coupler, and what is needed more than anything else is an insistance on a compliance with the M. C. B. contour lines, and rigid requirements as to strength.

F. A. Delano, Chairman; J. N. Barr, Thomas Fildes, John Mackenzie, Peter H. Peck, Committee.

The discussion on this paper was largely devoted to the matter of gages for detecting defects in the form of couplers which are not shown by the present standard gages. It appears that many couplers are now turned out with the heads not square on the shank, due either to unequal shrinkage of the casting or removing the couplers from the mold while they are still somewhat plastic.

Another important matter is that some manufacturers are found to be shortening the length of the guard arm to save their coupler from shocks. When this is done the other coupler, with a guard arm of full length, of course, has to take more than its share of the force of the blow. It is for this reason that the recommendation was made to increase the length of the standard contour lines, and oblige all makers to bring their guard arm lengths to a standard. A very important point was brought out by Mr. G. W. Rhodes, and we quote his remarks as follows:

If you go around the scrap-yards you will find that by far the greater proportion of the breakage of couplers are in the knuckles. I am afraid that so long as the railroad companies will submit to broken knuckles, the manufactureres will continue to make the kind that break and let the railroad companies buy knuckles at replacement prices. I believe that they will not be our best friends unless we mildly object to the kind of knuckles they sell to us, and what I would propose as a question for the railroad men to ask themselves and the coupler men to answer is, why do knuckles have such a large opening between the top and the bottom lugs? I think I have seen them with 2⅛-in. openings and quite a good many are 2 ins. What is the necessity of a 2-in. opening in a knuckle that is already weak? If I am correctly informed, some of the railroad men have been asked by, or have asked, the M. C. B. committee to recommend a solid knuckle, but, of course, at the present time a solid knuckle is hardly to be considered. There must be an opening between the knuckle lugs; but the question that I would like to ask is: why have a 2⅛-in. opening in the knuckle?

Some time ago we had 50 knuckles cast, and we have them now; we made the opening 1½-in., and we took the knuckles and distributed them on seven divisions of the C. B. & Q., putting them on way cars, so that they might meet the worst trouble of any coupler—if there are any links and pins left on a train, they are placed at the rear end; if there is any pushing out of yards by extra engines, it is at the rear end—and we have not had a solitary complaint from any of those 50 knuckles. While we are considering the question of strengthening drawbars for preventing breakages, it seems to me here is a capital opportunity to strengthen the knuckle. There is no reason why the link opening should be greater than 1¾ ins.; but I believe that so long as railroad people will buy these knuckles, the manufacturers will continue making such knuckles. The idea in making the opening 1¾ ins. is to admit the D section link. The ends of the D section are upset and are wider than the sides; the sides will always enter a 1½-in. knuckle opening. Trainmen soon discover this way of inserting coupling links.

EXPERIENCE WITH STEEL CARS IN WRECKS.

We have been furnished with the following official statement as to the experience with steel cars in wrecks of the Baltimore & Ohio R. R., prepared by Mr. Thos. Anderson, Master Car Builder of the Pittsburg & Western R. R.:

1. One of our trains of 100,000-lb. Schoen steel cars was going up an 80 to 90-ft. grade when ten cars broke off and ran away from the rear part about 90 car lengths. Four more of the steel hoppers then broke away, ran back down this grade, striking the rear part and damaging Pittsburg & Western steel car No. 4001 to the extent of two center sills badly damaged and buckled so much that it was necessary to cut them off and have the bent parts straightened and replaced by riveting on a plate both inside and outside of the channel. It required a new end sill, but the old end sill removed was in shape to be used in repairs to other cars, as we straightened and plated the fractured part so as to have it ready for other damaged cars. The material required amounted to $12.70 and the labor to $27.60, making a total of $40.30 to put the car into first-class condition.

2. Steel car No. 4351 was in an accident on the Baltimore & Ohio R. R. The cause of the accident is not known, but the car was sent home for repairs, having end sill, side sill, corner post and stake very badly damaged. We found, however, that we could make the necessary repairs very easily and put the car in first-class condition, by using one new end sill, one corner post and one side stake, and straightening out the side sill by building a fire under same and using hydraulic pressure to straighten it. The material used on this car amounted to $10.40, and for the labor $28.00, making a total of $38.40.

3. Steel car No. 4211 was derailed and went down a bank 10 to 15 ft. high, landing on the main track and blocking the road. Our Superintendent happened to be on board a passenger train which came up behind this wreck, and he cleared the track by use of engine and chains. This car was under a load of 100,000 lbs. of crushed stone. The sides were crushed in about 18 ins., bending all the side stakes on each side of the car, and breaking four journal boxes, one brake shaft, two hand holds, one winding shaft bent, drop door attachments bent, brake levers and guides torn off, truck channel bent and brake beams torn off. The pressed steel diamond truck under this car was subjected to a great deal of rough usage in getting main track cleared, and it may be reasonably supposed that the body of the car received some very rough handling to avoid delay to trains. I supposed that I would have to remove all the bent side stakes, but, fortunately, we made a good job by using hydraulic jacks and hammering on the stakes until we got the side straightened. The material required amounted to $8.37, labor $30.60, total $38.97.

I might add, for your information, that if a train of wooden cars had been subjected to the punishment that car No. 4001 received, there would have been nothing left of it but scrap. In this case this car was the only car damaged in the train, it being so solid and substantially built that all other cars behind it were protected.

NOTES AT THE NEW YORK ELECTRICAL EXHIBITION.

The electrical exhibition which is now being held at Madison Square Garden, New York city, is probably as successful a display, from the standpoint of the managers at least, as any which have preceded it in former years. Exhibits of heavy machinery, and devices of interest to engineers, are less numerous than in former years; but these are not the things which attract the public, and in its spectacular effects, and its display of things which interest the visitor who is neither electrician nor engineer, the exhibition is deserving of much praise.

As in the exhibition of last year, the main floor is given up to the heavier exhibits, while circling around the elliptical arena is a wide gallery overlooking the floor, and backed by the booths of smaller exhibitors. While heavier machinery is limited in amount, as already stated, among the few interesting things in this line are the field of a 400 K-W. direct current generator for electrolytic purposes, which weighs 20 tons, and stands in the center of the space allotted to the Crocker-Wheeler Co. Other exhibits in this line are a Sterling water-tube boiler complete without the brick casing; and a 300-HP. Ball-Wood tandem compound steam engine. The Fischer Equipment Co., the American Engine Co. and the Prindle Pump Co. should also be mentioned for their creditable displays of machinery in operation, which add considerably to the value of the exhibition. The Bryan-March Co. has an interesting sample of what can be done in the way of incandescent lamp manufacture in the form of a 5,000-candle power incandescent lamp, the globe of which is 3 ft. long and about 18 ins. in diameter. The carbon for this lamp is 15 ins. long and about ⅛-in. in diameter, and the lamp requires 13 K-W. of current at 236 volts, which makes about 55 amperes.

The Bullock Electric Co. show several machine tools run by electric motors, which afford an ob-

ject lesson in the simplicity of operating tools by electricity.

The most striking feature of the exhibition is the display of electric vehicles. In fact a large portion of the main floor is given up to five motor vehicle companies, who have from two to eight vehicles each on exhibition. These make quite a showing, even if they do look somewhat alike, and the indications are that the opportunity to closely examine the many types now afforded the public will be productive of a considerable increase in the use of this form of vehicle.

The exhibit of Government property is in the gallery, and consists of instruments and apparatus used in the army for field telegraphy and telephony, and in the navy for ship lighting and night signaling. The Agricultural Department also

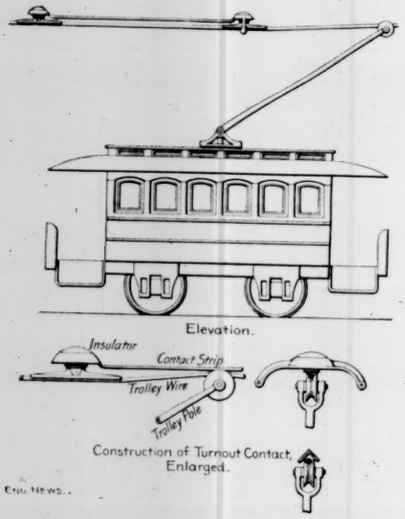


Fig. 1.—Details of Trolley Contact Plates.

shows instruments used in connection with the meteorological work of the weather bureau. Two search lights in this section, one from the wreck of the "Maine," and the other from the "Vizcaya," are placed side by side, and are generally the center of a curious crowd.

The exhibition is to continue until June 3.

AN AUTOMATIC BLOCK SYSTEM FOR SINGLE-TRACK ELECTRIC RAILWAYS.

The transition from slow-moving horse cars to electric traction has been accompanied in many cases with no change in the system of dispatching and spacing cars, and the natural result has been a number of more or less serious collisions. Experience in the movement of high-speed electric cars over suburban or country roads is proving that some such safeguards as experience has proved to be necessary for the safe movement of trains on steam railways will have to be applied to high-speed electric railways to make their operation safe.

We illustrate herewith an automatic block system which has been in successful operation for the past six months on a branch of the Lowell & Suburban Ry. in Massachusetts (Eng. News, Oct. 17, 1895), and has just been installed on the main line of the road. It is applicable to any electric railway either overhead or third rail, is easy to install, simple in operation and possesses other admirable features.

It is designed for single-track roads using turnouts, and is so designed that each car as it advances operates switches controlling the turnout which it is on and the one next in advance.

The apparatus used consists of contact plates placed at the turnout approaches and exits and automatic magnetic switches which are so interconnected that when a car leaves a turnout it automatically shuts the current off from the turnout next in advance on the side which a car would take coming toward the occupied turnout, and also shuts the current off from the side of the turnout which it leaves. The car upon reaching the next turnout replaces the switch.

In Fig. 1 the details of the contact plates, as used for overhead work, are clearly shown. It will be seen that two ordinary span wire hanger insulators are secured to the trolley wire a short distance apart, and these are connected by a copper strip or by a small light angle-iron hung just over the trolley wire. As the trolley wheel of the advancing car runs onto this section, the upward pressure of the trolley pole is sufficient to spring the trolley wire and press the flanges of the trolley wheel into contact with the copper strip or angle-iron. Current from the trolley wire can then flow along the wire leading from the strip or plate to the operating switch, seen in Fig. 2. The switch proper is contained in a weatherproof iron box secured to one of the trolley or feeder poles, at a convenient height for inspection. It consists of an insulated back upon which is mounted a pair of solenoids or coils, with a floating iron core. These coils have a resistance of about 1,500 ohms. To the middle of this core is attached a switch lever which is thrown on or off according to the direction of the current flow in the solenoid.

Fig. 3 is a diagram of the complete connections of a section of road near the power station, and including three turnouts (T_1 T_2 T_3). These may be, as is the case in actual practice, some distance apart. The right side of the turnout is in all cases the outbound track, the left being the inbound track. It will be noticed that the equipment of each turnout duplicates that of the others and consists of two switches (D S and U S), which are secured to convenient line poles, and five contact plates similar to those shown in Fig. 2. These contacts are placed on the curves of the turnout; two on the right track at A and B, and three on the left track at 1, 2 and 3. Circuit breakers or sectional insulators are introduced at points a, b, c and d, thus insulating the tangents of the turnouts and making them dependent upon the magnetic switches which connect or disconnect these sections with the feeder or trolley circuit at the proper time. The trolley wire of the curves of the turnouts always have current on so that current can be obtained for operating the switches, and for coasting onto the tangent of the turnout even if its wire be dead, although it is usual to remain on the live section until the five indicating lamps show that current has been

to the usual trolley or feeder poles is a sufficient conductor. If it is thought desirable, a three-wire insulated cable could be strung overhead or placed underground. While this latter course would be more satisfactory in many ways, its increased cost would make it of doubtful value, especially on country roads.

To fully understand the operation of the system in all its details, consider for the present a single car outward bound from the power station and refer to Fig. 4. It will be seen that the instant the trolley wheel strikes the contact plate (A) a circuit, shown by the light full lines, is estab-

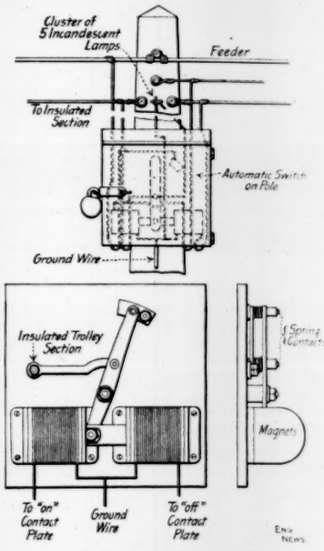


Fig. 2.—Switch-Box on Pole, and Details of Automatic Switch.

lished through the switch D S_1, and its blade is thrown to the "on" position, and the inbound side of the turnout is made alive, so that should there be an inbound car on that section, at the time, it would be able to proceed. As the up-switch U S_1 controlling the right hand tangent of the turnout, is "on," the outbound car can continue. As soon as it strikes the contact plate (B), thus connecting the plate with the trolley wire, the circuit indicated by the dotted line, Fig. 4, is energized. If this is traced out it will be noticed that the current will open the switch U S_1, which supplies the section it was just on and makes it dead, while at the same time it opens the down switch D S_2 of the turnout just ahead (T_2) and prevents any cars from leaving the inbound side of that turnout. The outbound car continues on its way with a feeling of absolute security, for, figuratively speaking, it holds the key which unlocks the approaching car. This process is repeated at each turnout.

Now, suppose a car coming in the opposite direction; that is, inbound. The operation in this

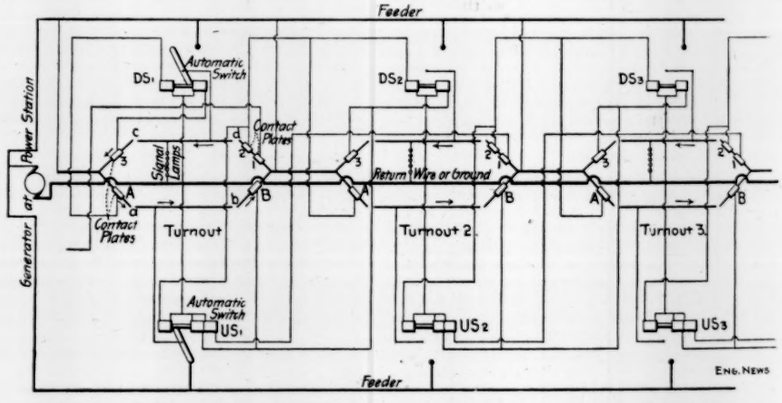


FIG. 3.—DIAGRAM SHOWING COMPLETE CONNECTIONS FOR THREE TURNOUTS.

turned onto the insulated section. When a car runs on a dead section it coasts and finally comes to rest, after which it cannot start until the automatic switch is thrown and the connection with the feeder is re-established. In Fig. 2 a return wire is shown, but this is not essential, as the ground or track return may be used exactly as in the case of the main current for operating the car motors.

For the proper interconnection of the switches of each turnout with the one ahead, three wires are run from turnout to turnout, but as the current required to operate the switches is small, about ½-ampere, ordinary No. 8 B. & S. iron telegraph wire and porcelain knob insulators attached

case is made clear by Fig. 5. The car swings around the left hand curve of the turnout (T_2), and, as in the former case, the trolley wheel makes contact with plate (1). The circuit shown in full light lines is thereupon thrown into action and the switch D S_2 of the left hand tangent of (T_2) is thus made alive so that the car we are considering can run upon it. However, as the car advances and before it runs upon the tangent, contact is made with plate (2) and the circuit indicated by dotted lines comes into play. This it will be seen closes the switch U S_2 of the turnout (T_2), thus energizing the right or outbound side of (T_2) and at the same time opening the switch U S_1, which thus prevents the outbound car or cars leaving turnout (T_1).

Running the length of the tangent and swinging onto the main track the trolley wheel hits plate (3) and deadens the tangent just left by the inbound car under consideration, by opening the switch D S_2 through the circuit indicated by the dash line. As in the former case, this operation is repeated at each turnout. The direction of current flow has been assumed in each case from the trolley through the various ramifications of the circuit to the return wire or ground, and is so indicated by the small arrows. Should two cars running in opposite directions strike the first contact plates of adjacent tangents of a turnout at the same time, one of them would be stalled for want of power and the other could proceed, for, as has been explained, the power is cut off from the one side on the entering of a car, and from the other on the leaving of a car, so that the car which cuts the power off from the next turnout in advance, on entering its own turnout would have the right of way.

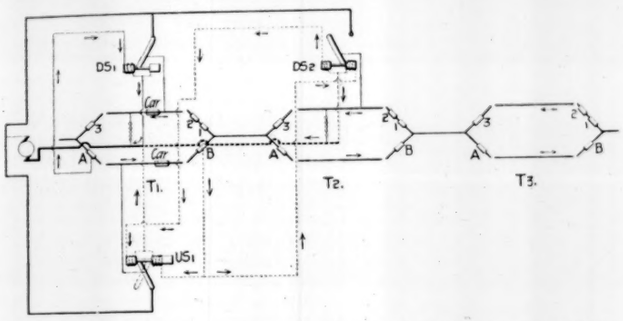


FIG. 4.—DIAGRAM SHOWING OPERATION OF AUTOMATIC SWITCHES, WITH AN OUTBOUND CAR ENTERING AND LEAVING A TURNOUT.

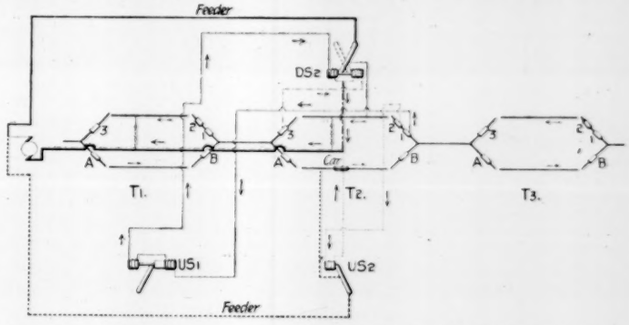


FIG. 5.—DIAGRAM SHOWING OPERATION OF SWITCHES WHEN AN INBOUND CAR ENTERS AND LEAVES A TURNOUT.

The illustrations Figs. 3, 4 and 5 are purely diagrammatic and are intended to illustrate only the principle, as the practical application can be varied to a considerable extent to suit conditions.

At night, if a car should run on the dead section of a turnout, the car lights would go out and the electric car heaters would be shut off if in use, and this would naturally be unpleasant for passengers. To prevent this five incandescent lamps are connected between the insulated trolley section and the ground. These are mounted on a suitable bracket secured to one of the trolley poles, and form a signal. If burning, the motorman knows that current is on the turnout and he can proceed, if not burning as he approaches the turnout, he stops before striking the insulated section. The same thing applies in the winter when the electric heaters are in use.

The cost of the system is about $200 per turnout installed, when the turnouts are about one mile apart, as on the Lowell & Suburban line. The automatic switches cost $25 each.

For the material from which this description was prepared we are indebted to Mr. Chas. F. Bancroft, Electrical Engineer of the Lowell & Suburban Street Ry. Co., who is the inventor of the system.

A NEW INSULATING MATERIAL suitable for a variety of purposes, requiring a fireproof, acid-proof or frostproof insulator, with considerable mechanical strength, is being made of choice Maine granite, which is pulverized, mixed with a binder, molded and finally fused at a temperature of about 3,000° F. It is claimed that the material, which is called reconstructed granite, is so completely vitrified that it cannot absorb moisture. Its crushing strength is said to be 14,560 lbs. per cu. in. and its tensile strength from 480 to 500 lbs. per sq. in. A test at Niagara Falls showed that fully 56,600 volts pressure were required to puncture ½-in. of the material after soaking the test piece for several hours. The granite is manufactured by the Reconstructed Granite Co., of New York city, whose works are at Norristown, Pa.

ESTIMATE FOR A 1,537-LIGHT MUNICIPAL ELECTRIC LIGHTING PLANT FOR SAN FRANCISCO, CAL.*

In accordance with a resolution passed by the Board of Supervisors of the city and county of San Francisco, a report has been prepared to show the cost of an electric plant for lighting the streets and municipal buildings of San Francisco, and the approximate yearly cost for operating the same.

To afford material for a fair comparison between the present cost of lighting and the cost of an electric system operated by the city, all buildings at present lighted, and arc lights to cover the present illuminated and settled portion of the city were included. With this as a basis it was determined that 1,537 arc lights would be required for street and park lighting, while 300 K-W. of current would be needed for buildings and general interior lighting, for which the alternating incandescent system was favored with a line voltage of 2,200 volts, and transformers located just outside the buildings to drop the pressure to 100 volts.

In the business section the report contemplates putting all wires underground, in a conduit consisting of two dipped iron pipes and suitable brick manholes placed about 200 ft. apart. In this locality ornamental iron poles would be used, while elsewhere wires and lights would be hung on 40-ft. wooden poles placed 150 ft. apart.

TABLE I.—Estimated Cost of Steam and Electric Plant and Distribution System for Operating 1,537 Arc Lights.

1.	Steam plant consisting of boilers to evaporate 40,000 lbs. of water per hour, 7 engines of 250 HP. each, 2 engines of 125 HP. each, surface condensers, feed pumps and feed water heaters	$73,030.00
2.	Piping, valves, etc.	7,500.00
3.	Erection of engines, boilers, condensers and heaters	14,629.00
4.	Induced draft blowers, connections and short stacks	5,000.00
5.	12 150-light arc machines, erected	32,400.00
6.	Arc light switchboard	300.00
7.	1 150-K.-W. alternator, 2 75-K.-W. alternators, erected	5,740.00
8.	Alternating current switchboard	1,950.00
9.	1,500 arc lamps, complete	30,000.00
10.	121 ornamental iron poles, in place	7,260.00
11.	5,774 wooden poles, 7×7 tops, 12×12 butts, 40 ft. long, in place	63,514.00
12.	5,881 6-pin cross arms	1,470.00
13.	13,000 insulators and pins	520.00
14.	93,333 ft. double 2-in. iron, pipe conduit, laid at 42 cts. per ft.	39,199.86
15.	450 manholes, complete	22,500.00
16.	49,980 ft. No. 00 rubber covered cable*	9,996.00
17.	30,660 ft. No. 1 rubber covered wire*	4,139.10
18.	71,980 ft. No. 4 rubber covered wire*	6,838.10
19.	124,100 ft. No. 6 rubber covered wire*	10,548.50
20.	1,120,809 ft. No. 6 rubber covered wire (special)*	95,268.76
21.	96,333 ft. rubber covered, lead and jute armored No. 6 wire (special)*	8,188.30
22.	Converters, 43—1-K.-W., 5 2-K.-W., 1 3-K.-W., 1 10-K.-W., 7 25-KW.	3,042.00
23.	Stringing wire	3,972.00
24.	Power station	12,000.00
25.	Real estate	
	Total, excluding real estate	$459,005.43

*The present cost of copper is about ⅓ more than it has been for several years. The figures given in this table could, of course, be shaded by those submitting bids.

*Abstract of a report submitted to the Mayor and Board of Supervisors of the City of San Francisco, Cal., by Mr. A. W. Hunt, Consulting Engineer.

The generating station, as outlined in the report, would consist of a suitable building containing 12 150-light arc machines belted in pairs from compound vertical steam engines and three 2,200-volt alternating current generators for incandescent lighting, also belted from the same type of engine. One of these alternating generators would be a 150-K-W. and two of 75-K-W. output. The engines would ordinarily run condensing, but would be arranged to exhaust to the atmospheric when desired.

The experts were required to consider the possibility of a limited amount of commercial lighting, such as the illumination of stores, private residences, etc. To meet this vague and very general condition additional estimates were made on the apparatus necessary to install and operate 300 arc lights, which was assumed as a fair number, all things considered. In the accompanying tables (Tables I. and II.) the estimated cost of the entire plant, and the total yearly operating expenses are given in considerable detail.

The cost of 300 additional arc lamps for commercially lighting, and the increase in equipment necessary to operate them, added $53,290 to the total plant cost, given in Table I., so that the complete system, consisting of 1,837 arc lamps and 300 kilowatts supply for incandescent lamps, the distributing system and the central station, amounts to $562,295, or not far from the cost of the Detroit municipal lighting system (Eng. News, Sept. 8, 1898), which this one would closely resemble.

Regarding operating expenses, the 300 additional lamps would, it is estimated, cause a yearly increase of about $27,790 in operating expenses, so that the total operating expenses would be approximately, $198,628, or, assuming that wages are taken at the same rates as would be paid by private parties, the cost of operating 1,837 arc lamps and 300 K-W. of incandescent lamps, is estimated at $188,868, a figure which is certainly large enough to cover all contingencies.

TABLE II.—Annual Cost of Operation.

Bond interest 3½% on $459,005.43	$16,065.19
Coal, 8,341¼ tons at $7.25, in bunkers	60,473.75
Depreciation (10 years life) 9.1% on items 9, 11, 12, 13 and 23	9,052.32
Depreciation (13 years life) 6.4% on items 1, 2, 3 and 4	6,410.18
Depreciation (15 years life) 5⅓% on items 5, 6, 7, 8 and 22	2,258.46
Depreciation (20 years life) 3⅓% on items 10, 14, 15, 16, 17, 18, 19, 20 and 21	7,137.85
6 firemen at $75 per month	5,200.00
3 engineers at $100 per month	3,600.00
3 oilers at $75 per month	2,700.00
5 dynamo tenders at $90 per month	5,400.00
1 boiler cleaner at $75 per month	900.00
2 horses and wagons at $40 per month each	960.00
20 trimmers at $75 per month	18,000.00
2 linemen at $90 per month	2,160.00
Store keeper and time clerk	1,200.00
3,000 carbons per diem, 325 days, at $9.00 per 1,000	8,775.00
Waste	200.00
Oil	2,555.00
Globe renewals and repairs	1,500.00
Stores and supplies	1,200.00
Chief Engineer and Superintendent	3,000.00
Insurance ¾% on $150,000	1,125.00
Water assuming waste per diem to equal ¼ of feed	975.84
General repairs (approximated at 2½% on entire plant)	9,989.70
	$170,838.29

Note.—The rate of wages on which this table is based corresponds to those paid by the city in similar cases, but if the rates be taken at those paid by private parties, the estimate may be reduced by $8,560.

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The use of bituminous coal instead of anthracite is steadily increasing in various parts of the Greater New York, notwithstanding various laws and ordinances and newspaper protests. Under present conditions, bituminous coal can be laid down in New York for considerably less per ton than the pea, buckwheat, rice and other grades of anthracite which are used for steam raising. In addition to this, the bituminous coal is a better grade of fuel and increases the steaming capacity of boilers fired with it. Naturally there is a strong desire on the part of manufacturers and others having large steam power plants to change from anthracite to bituminous.

On the other hand, ordinances are in force absolutely prohibiting the use of soft coal in certain portions of the city, and some of the newspapers, notably the "Tribune," are making an active crusade for their enforcement. It appears to us, however, that such ordinances are radically wrong in principle. What should be forbidden is the discharge of offensive smoke from chimneys, not the use of a particular kind of fuel. The fact may as well be fairly faced, that the deposits of anthracite are limited in extent, and with the working out of the most accessible and easily-worked veins, its cost is certain to increase. The waste or improvident exhaustion of natural resources is in fact one of the greatest defects of modern civilization. If when natural gas was first discovered and made use of, some autocrat could have sternly limited its use to domestic fires and those industrial applications in which it is peculiarly valuable, and could have prevented the drilling of wells beyond what was necessary to supply the demand for these purposes, the probabilities are that a large section of the country could have enjoyed the blessings of natural gas fuel for a century or more. As it is, the natural gas deposits will be nearly all exhausted within little more than a score of years from its first extensive use. One would suppose that our experience with natural gas would teach us a lesson with respect to the waste of our resources in anthracite. It is wrong to burn this ideal domestic fuel under steam boilers, where soft coal would give even better service, and can by the use of the proper appliances be burned with only trifling emission of smoke. The substitution of soft coal in place of anthracite in the large steam power plants of Eastern cities is, therefore, a matter of public benefit rather than the reverse. Of course, we are assuming that the soft coal is burned in such a manner as to avoid smoke, but there is no reason why this should not be done. As a matter of fact, we suspect that the ordinances forbidding the use of soft coal are practically interpreted in this way, and the steam user who uses soft coal is not molested so long as his chimney is not seen to give off black smoke.

At the last annual meeting of the Street Railway Association of the State of New York, Mr. W. Caryl Ely, of Buffalo, N. Y., stated that in his judgment "the only safe way to run at high speeds on a single track electric railway was to double track it, and double track it quick." This may do for a maxim where there is traffic sufficient to support a double track road, but there are thousands of miles of electric railway where double-tracking is out of the question. Nevertheless the matter of safe operation is one of fast growing importance.

In the early days of electric railway operation, when slow speeds, light cars and short lines were the rule, the old horse car methods of operation were continued in use, and no trouble resulted. Later, when steam railway conditions were approached, it was found that collisions could occur between trains propelled by electricity as well as between those propelled by steam.

Electric railway managers were slow, however, to admit the necessity of greater precautions. One of the prime causes of the rapid development of electric railways for country and suburban service has been the cheapness of installation and operation, and this cheapness has been at least partly due to the omission of some items regarded as essential in steam railway practice.

With the growing accident record, the accompaniment of damage suits, and the increased tendency of juries and courts to award large sums to the plaintiffs in accident cases, electric railway officers are coming to realize that to save money by dispensing with systems and devices designed to secure safety is a very dear economy. Public opinion and state and municipal legislation are also pressing them toward the adoption of safety devices, and the demand for a safe and expeditious system of moving cars on a single track road is becoming imperative.

Fortunately the problem of introducing an automatic block system on a single track road is much simpler on electric railways than on steam. We illustrate on another page of this issue a system now in operation on a railway in eastern Massachusetts which is well worth careful study by electric railway managers.

With this system each car as it advances absolutely prevents another car from entering the block on which it is moving at either end. This it does by cutting off the current from a section of the trolley wire on the turnouts at either end of the block. As it passes out of the block it automatically restores the current to the section in its rear and cuts it off from the section in advance.

The system in its entirety and the apparatus employed are extremely simple and not liable to derangement, while the fact that a car is given positive information as to whether the track ahead of it is clear or not is of value in expediting the movement of the cars and increasing the traffic capacity of the road.

DISCUSSIONS OF PAPERS BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

"The American Society of Mechanical Engineers" holds fewer meetings than any other of the national engineering societies." This sentence was the opening one in an editorial note published in this journal five years ago; and what we then said is true to-day. The Civil and the Electrical engineers hold regular meetings throughout most of the year, the former, fortnightly, and the latter monthly. The Mining Engineers, with no local habitation at all, hold three meetings a year. The Mechanical Engineers, however, still follow the custom established when the society was founded, of holding only two meetings a year, the one in New York in the winter, and the other in some other city during the months of May or June.

At these summer meetings especially there has been a strong and growing tendency to "railroad through" the presentation of papers, leaving no time for anything more than perfunctory discussion, in order that more time should be available for excursions. At the recent Washington meeting, for example, the presentation and discussion of seven papers, some of them the most important and valuable on the entire program, was compressed into the final session, occupying considerably less than two hours. The authors of papers which receive such cursory treatment naturally feel aggrieved, and have a right so to feel. They do not go to the trouble of preparing papers merely for the sake of having them buried in the bound volumes of the "Transactions." It we mistake not, in almost every case, the author of a paper desires full discussion upon it—the criticism of his professional brethren upon his work—and he naturally feels disappointed when he finds that the time available for his paper is not sufficient to give him even the ten minutes to which he is entitled by the Society's rules for its presentation, to say nothing of any time for discussion.

The American Society of Mechanical Engineers is not alone in finding that excursions at the summer meetings encroach upon the time devoted to professional sessions. The Civil Engineers have long had the same experience, and have just taken the radical step of abolishing entirely the presentation of papers at the summer convention, and also at the annual meeting in January. Discussions will take place if the members are in a discussing mood, but they will be devoted to the papers which have been presented during the preceding six months or to topical questions.

The Mechanical Engineers cannot follow this excellent example, since, as already stated, they have at present no other meetings than their general semi-annual conventions, at which papers can be presented. The propostion to hold monthly or semi-monthly meetings of the Society has been debated, we believe; but has heretofore been defeated in the governing body of the Society, on the plea that if such meetings were held in New York there would be complaint among members of the Society resident in other parts of the country, that the members resident in New York and vicinity were receiving more than their share of the benefits from the Society. This seems rather a curious argument in view of the fact that the Civil Engineers, whose membership is much less concentrated in the East than the membership of the Mechanical Engineers, has always held its fortnightly meetings in New York as well as its annual meeting, and holds only one meeting a year outside of New York, and that the summer convention, devoted more to pleasure than to business.

Again it will be evident that so far as the argument is valid, it is rather an argument for holding meetings in cities in different parts of the country than for not holding them at all. In this matter the Electrical Engineers are unquestionably in advance of all the other national engineering societies. As our readers will recall, notwithstanding the youth and comparatively small membership of this society, it has successfully carried out the plan of holding meetings simultaneously in New York and Chicago, the same paper being presented and discussed at each meeting.

Recently the Junior Members of the Mechanical Engineers have arranged for the holding of special monthly meetings at the Society's House in New York city during the winter months, and no protest is heard from the Juniors residing in parts of the country distant from New York. Remembering that Juniors have exactly the same rights as other members in the presentation and discussion of papers at the regular meetings of the Society, it will not be strange if full members of the Society begin to ask why, if it is possible to hold monthly meetings by the Junior members of

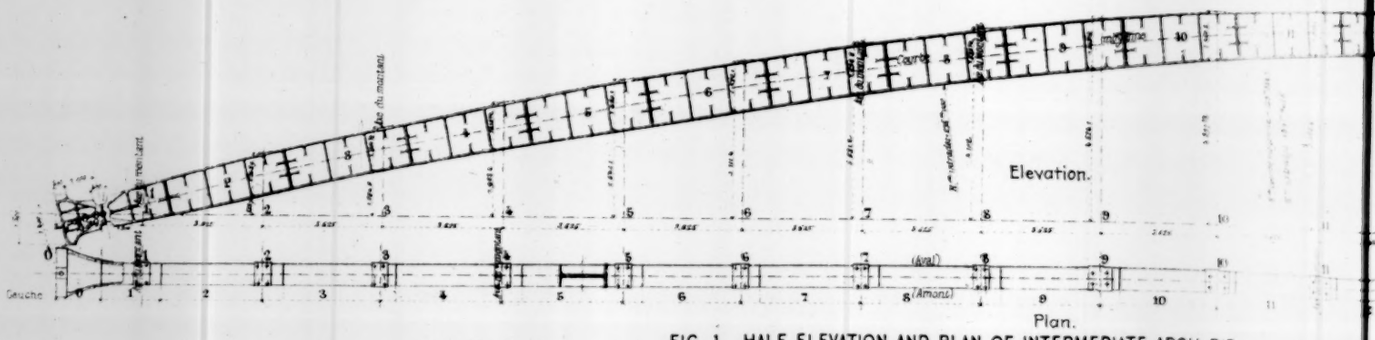


FIG. 1. HALF ELEVATION AND PLAN OF INTERMEDIATE ARCH RIB

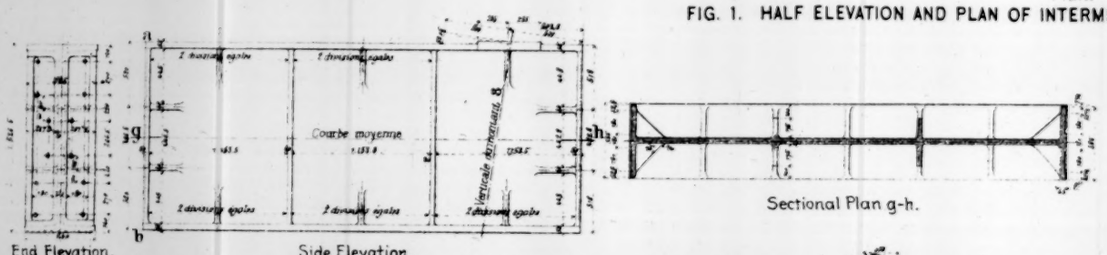


FIG. 2. DETAILS OF ORDINARY VOUSSOIRS, INTERMEDIATE ARCH RIB.

FIG. 3. DETAILS OF HINGE

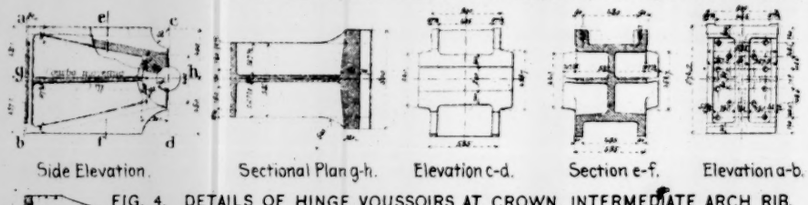


FIG. 4. DETAILS OF HINGE VOUSSOIRS AT CROWN, INTERMEDIATE ARCH RIB.

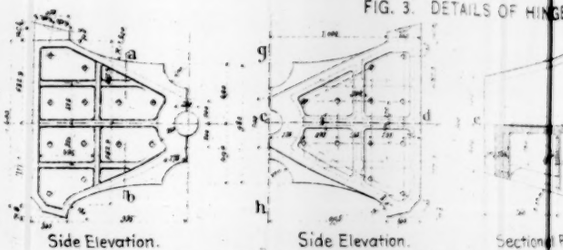


FIG. 5. DETAILS OF BEARING SHOES AT ABUTMENT HINGES, IN

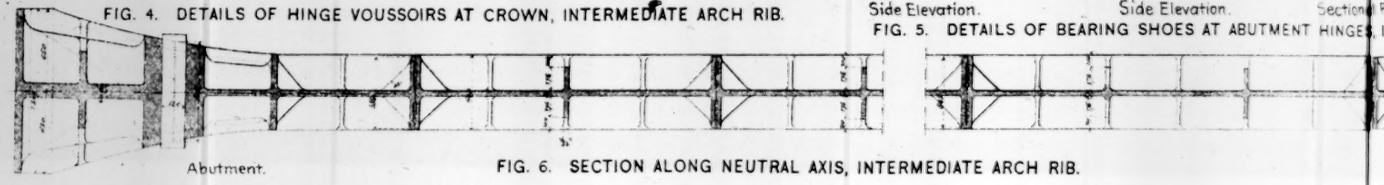


FIG. 6. SECTION ALONG NEUTRAL AXIS, INTERMEDIATE ARCH RIB.

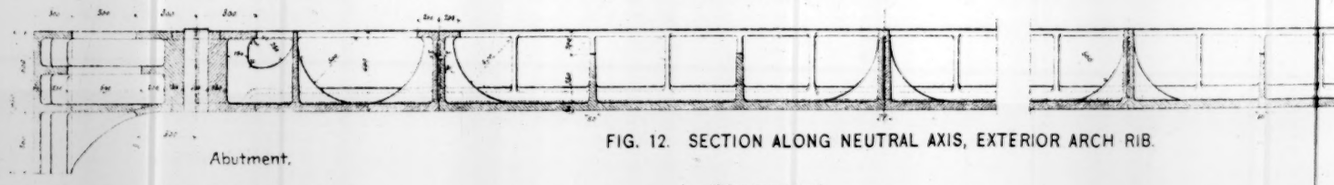
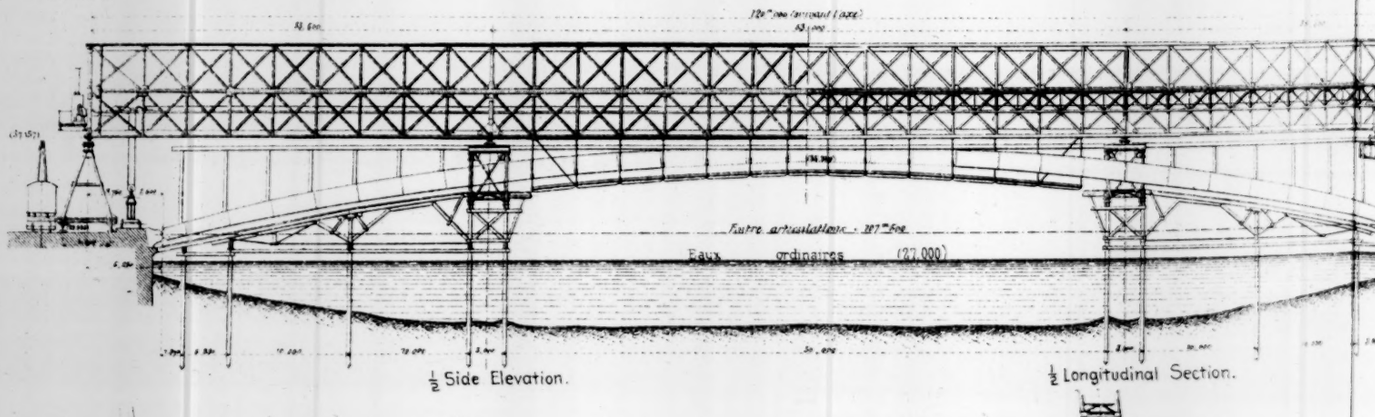


FIG. 12. SECTION ALONG NEUTRAL AXIS, EXTERIOR ARCH RIB.



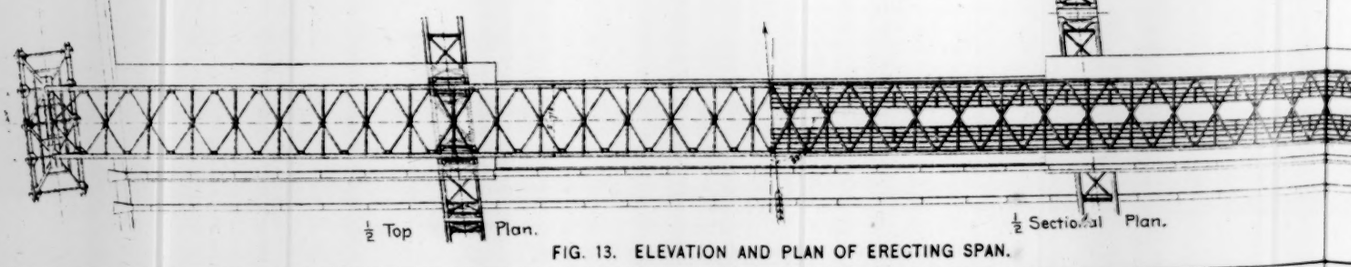
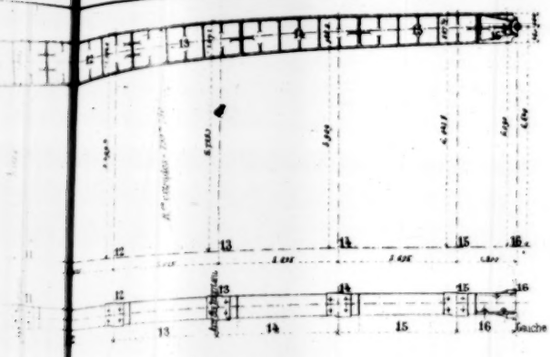


FIG. 13. ELEVATION AND PLAN OF ERECTING SPAN.



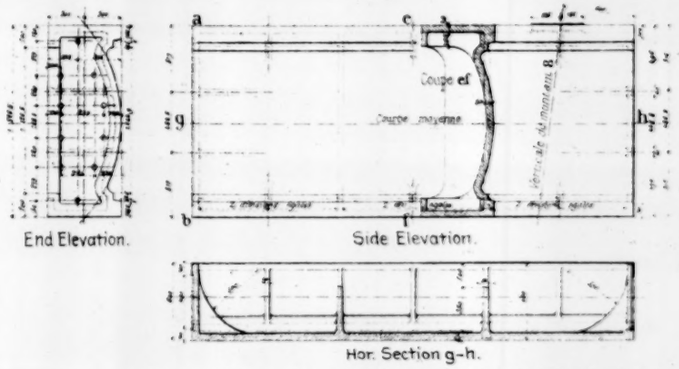
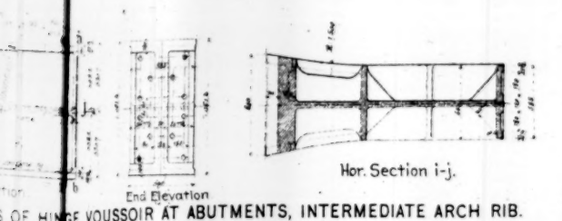


FIG. 8. DETAILS OF HAUNCH VOUSSOIRS, EXTERIOR ARCH RIB.



OF HINGE VOUSSOIR AT ABUTMENTS, INTERMEDIATE ARCH RIB.

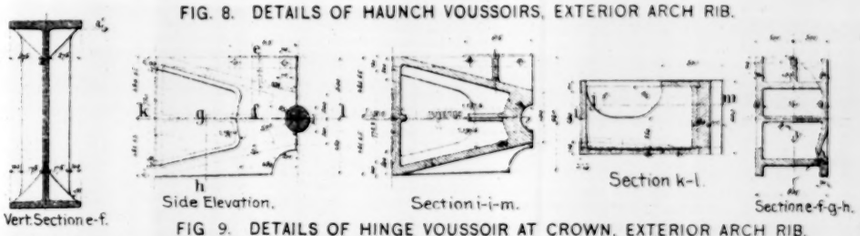
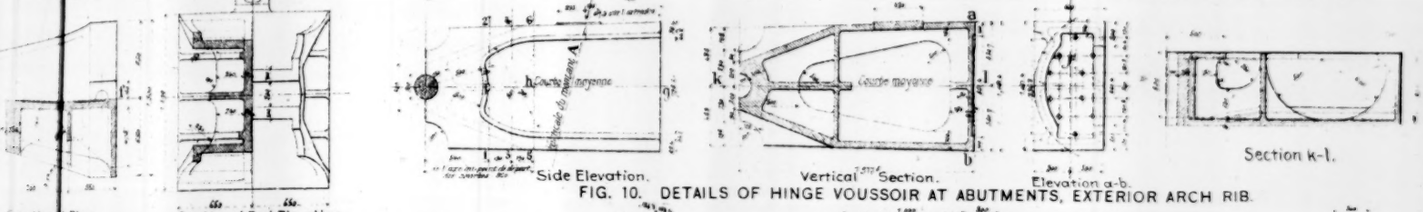
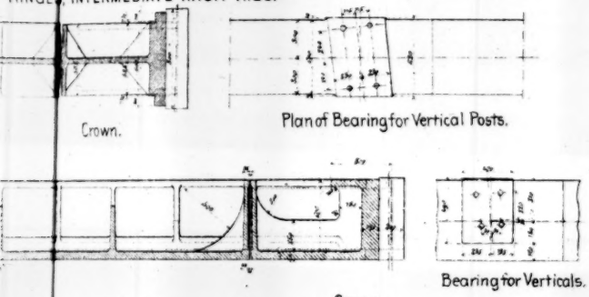


FIG 9. DETAILS OF HINGE VOUSSOIR AT CROWN, EXTERIOR ARCH RIB.



HINGES, INTERMEDIATE ARCH RIBS.

FIG. 10. DETAILS OF HINGE VOUSSOIR AT ABUTMENTS, EXTERIOR ARCH RIB.



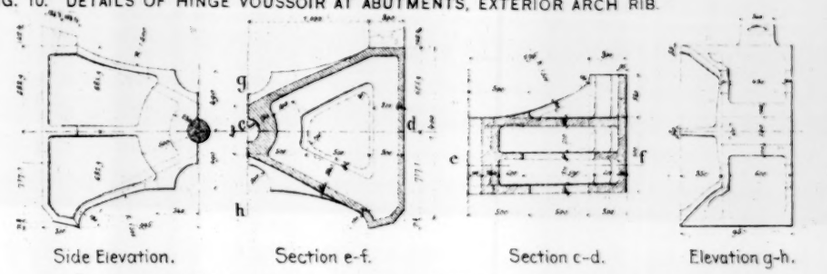
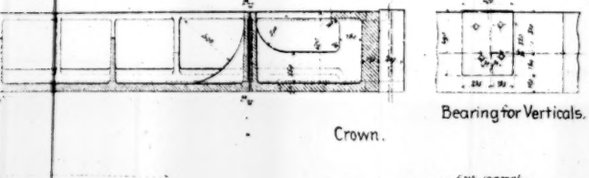


FIG. 11. DETAILS OF BEARING SHOES AT ABUTMENT HINGES, EXTERIOR ARCH RIB.



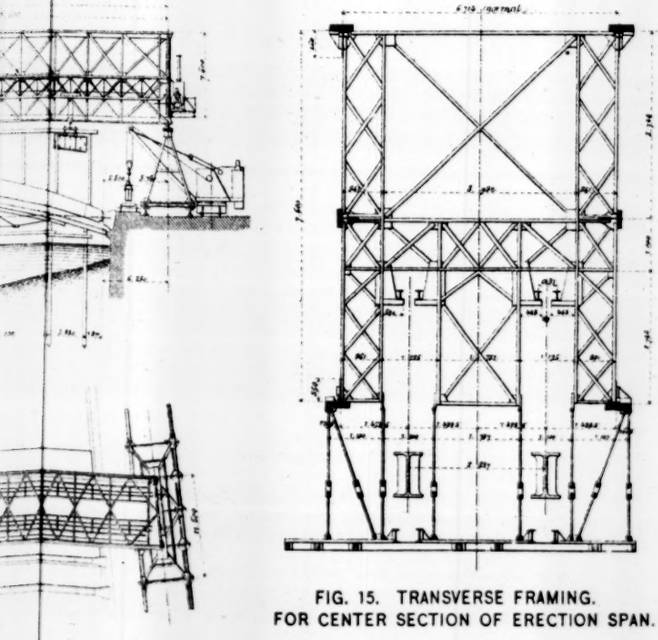


FIG. 15. TRANSVERSE FRAMING.
FOR CENTER SECTION OF ERECTION SPAN.

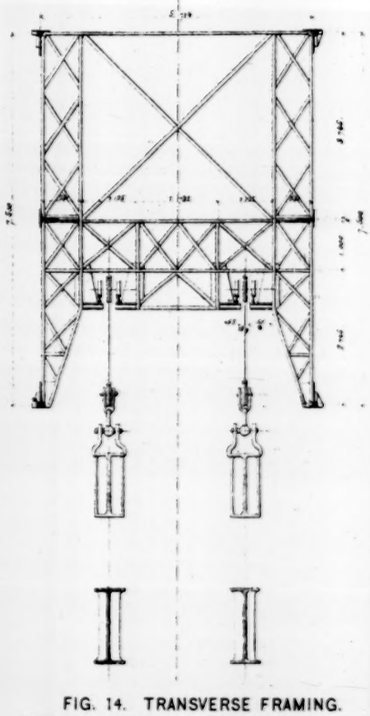


FIG. 14. TRANSVERSE FRAMING.
FOR END SECTIONS OF ERECTION SPAN.

BRIDGE

ALEXANDER III,

PARIS,

FRANCE;

Construction

and Erection

of

Arch Ribs.

CHAS. HART, LITH., 39 VESEY ST., N. Y.

the Society, at least as much cannot be done for the general membership? If the concentration of the Society's meetings in New York is objected to, there is no reason whatever why monthly meetings should not be held throughout the year in different cities. The papers presented at these meetings could then form the subject for continued discussion at the summer convention and the annual meeting in December, as is now the practice in the Civil Engineers' Society.

It will be understood that we are by no means arguing for the curtailment of the excursions, with their combination of recreation and instruction, meetings. What we do urge is that the technical work of the Society should not be sacrificed on this account, as is at present unquestionably done. Under present conditions, an engineer who prepares a paper for presentation to a society will find more attention paid to his contribution and fuller discussion upon it if it be read before some of the larger of the local engineers' clubs than if it be presented to the Mechanical Engineers. There is no need at all that this should be the case. The Mechanical Engineers attend their meetings in larger numbers, and are more prompt and ready with discussion upon papers read before them than the members of any other national engineering society. All that is needed is fair opportunity to cause every paper read before them to receive such full discussion as every paper for permanent record in an engineering society's transactions should receive, in order that its excellencies may be emphasized, and its errors may be made plain.

We have alluded to the complaint that too much of the work of the Society is centered in New York. That there is more or less reason in this complaint is not to be denied. Too many members of this Society, and of all the national engineering societ' for that matter, are able to attend a general meeting only once or twice in a decade. The proposition to hold meetings in different parts of the country was once before the American Society of Civil Engineers, but it was complicated by questions of affiliation with the local engineering societies, which caused its defeat. The Mechanical Engineers have now the opportunity to take a step in advance of any other national engineering society. If, in place of holding two general meetings a year, they should hold one general meeting, the summer convention, and a series of half a dozen monthly meetings during the year, let us say in Boston, New York, Philadelphia, Pittsburg, Cincinnati and Chicago, a much larger proportion of the membership would find opportunity to attend meetings, and increase their interest in the Society. Of course, these proposed local monthly meetings would not be such elaborate affairs, entailing heavy burdens upon the local members, as the summer conventions have now become. One or two sessions for the reading and discussion of papers would comprise the whole program.

We make this suggestion merely to meet the argument that has heretofore been made against the holding of more frequent meetings by the Society. It is of course not essential to our main proposition. The papers for the Transactions can be presented at monthly meetings in the Society's house in New York, if the officers of the Society deem best, and will receive, we are sure, better justice than they now receive at the summer conventions. It is a noticeable fact that the average attendance at the annual meeting, which is always held in New York, is above that at the summer meetings, with all their additional attractions in the way of excursions. This would indicate that more frequent meetings in New York would be at least as well attended as those of the other national engineering societies.

In this connection, it is worth noting that the Society has just effected a very wise reform, by sending out to all members of the Society advance copies of papers to be read at the meetings instead of sending to those alone who signify their intention of attending. We trust that further improvements, designed to increase the usefulness of the Society, to all its members, and to increase the value of its technical work, may soon be inaugurated.

LETTERS TO THE EDITOR.

The Train Service on the Long Island R. R. Tunnel Extensions to New York.

Sir: The editorial article in your last number on the subject of the projected Long Island R. R. improvements is in error in one very important particular. Flatbush Ave. station will be merely a way station on completion of the work. All trains will run through from Manhattan to either Jamaica, Manhattan Beach or Rockaway Beach. No steam trains will be run on any part of Atlantic Ave., and all transfers will be made at Jamaica for all points to the East. Yours faithfully, J. V. Davies.

32 Nassau St., New York, May 22, 1899.

(Our information was obtained direct from official sources, but doubtless Mr. Davies speaks with authority. It will be seen that his statements indicate that the work of equipping the Long Island railway lines with electricity will be carried out even sooner than we prophesied in our editorial.—Ed.)

Borings in Gravel.

Sir: In reply to the inquiry in your issue of May 4, I will say that it is not necessary to use a 2-in. pipe enclosing a 1-in. water pipe. A 3-in., or even 4-in., casing pipe may be used with a ¾-in. water pipe. With sufficient water pressure large gravel can be forced up between the two pipes. If, however, larger sized gravel is encountered than will rise up between the pipes, a pipe-bucket, with valve near its bottom, may be inserted in the 3 or 4-in. casing pipe; lifting and dropping this with short, quick strokes will soon fill it with any material not too large to pass its valve.

If larger gravel than can be handled by either of these methods is met, then employ a heavy drill, either with blunt end, or with star-cutting end, which can be lifted with block and pull. A series of rapid blows will break or crush the gravel so that it may be removed by one of the above methods; or, perhaps, drive some of the larger pieces downward and laterally clear of the pipe. To force large sized gravel by water jet, the ¾ or 1-in. water pipe should have full opening at bottom, and not be throttled by contractions at its lower extremity. W. M. Patton.

Va. Polytechnic Institute, May 8, 1899.

Comparison of Electric and Hydraulic Passenger Elevators for High Buildings.

Sir: In the article in Engineering News for April 27, describing the Sprague electric elevator, you state under the heading of economy that the elevator "works in proportion to its load, actually returning current to the line when the car descends fully loaded."

This is untrue. The Sprague elevator is under-counterweighted and the descent of the empty car is made by gravity alone. Nearly all of the energy of the descending car and the entire amount due to the load is thrown away in a large rheostat on the rear of the controlling switchboard, and the current cannot be returned to the dynamo under any conditions.

There are several other methods of operating elevators that are much simpler and more economical, in which the car is over-counterweighted just to balance the average load. There are no rheostats employed and the motor returns current to the dynamo when the car descends fully loaded or ascends under-loaded, the only true load on the dynamo being the current lost in the motor and that required to overcome the friction of the machinery and car.

These systems are much superior in every way to the complicated and wasteful rheostat method which is now out of date, but the elevator trust refuses to pay royalty on patents or to adopt new things.

You should make this correction, as the statements in the article are likely to mislead some people into thinking that the elevator described is the most efficient known, whereas, in fact, much more satisfactory service may be obtained with modern apparatus that requires less than one half the power to operate. Yours truly,

S. W. Rushmore.

Jersey City, N. J., April 28, 1899.

(The drum type of elevator, of whatever make, is correctly outlined in the article to which reference is made. This type is almost invariably arranged so that the car is overbalanced by its counterweight by an amount equal to the average load in the car. The motor of all drum elevators is shunt-wound, except those machines that have a few series turns used only in starting, and current is admitted to the armature to drive the machine and car on both the up and down motion, the armature connections being reversed to produce the respective motions. It is readily seen that when the machine is hoisting the empty car, or when it is lowering a loaded car, it is being driven by its load in the same direction that it is driven by the current. This will, of course, increase the speed of the armature above its normal speed, and as the full field strength is maintained the motor will act as a generator, since its counter E. M. F. will exceed the potential of the line. It will, therefore, force current back into the line and act as a dynamic brake to retard the load and limit the speed of the car to a very little over its normal speed. Forty-eight of these machines are now being installed by the Central London Ry. of London, England.

In the screw type of elevator, as our correspondent states, the car is underbalanced and at all times heavier than the counterbalance system. The motor is a compound-wound one with the series field in excess of the shunt. In hoisting any load from an empty car to full load, the motor is always driving an actual load. In descending, the motor is not driven as such at all, but is connected across a variable rheostat and driven as a generator by the excess weight of the car. The potential across the terminals of this series generator, so operated, does not attain that of the line supply, and is not, as was stated in the article, connected across the line, so that it cannot return current to it. It is possible to arrange this type of machine as it now exists in connection with storage batteries, so that part of the energy which is developed in the down trip may be stored up and utilized. This has not been done, we are informed by the Sprague company, because the necessity for utilizing this energy has never appeared with sufficient force to warrant the arrangement for it. The company claims that the screw machine has a hoisting efficiency greater than any but the very best drum type machine. The operating efficiency or average current per trip for corresponding loads is less for the best of drum machines. But for the class of work for which the screw machine is used the efficiency is not the matter of chief importance, and efficiency was in its design sacrificed to some extent for the qualities of safety, facility and ease of operation and adaptability. In all these qualities it far exceeds any drum type of machine. Such duty as is required in the Park Row Building, with its long stretch and number of ropes, high speed, and the safety requirements is impracticable with the drum type of machine as at present constructed.

Under the head of safety, there are other points in favor of the screw type elevator which are valuable, and which might have been added to those mentioned in the article. One is that the screw type of elevator replaces a water column, which is absolutely dependent for its supporting power upon any single valve or pipe connection, by a solid steel bar with a tensile strength of more than 100,000 lbs. per sq. in.—Ed.)

Notes and Queries.

Correction.—By a printer's error, in connection with a report on a test of soil at New Orleans, published in our issue of May 11, it was stated that the tests were conducted by Mr. F. J. Llewellyn, M. Am. Soc. C. E. They were really made by his brother, Mr. F. T. Llewellyn, who is the New Orleans representative of the Gillette-Herzog Mfg. Co., of Minneapolis.

The article also read as if a load of 1,000 to 1,500 lbs. per sq. ft. was that commonly assumed for foundations in Minneapolis, whereas these figures are the ones generally adopted for foundations in New Orleans. In the particular case described, the soil was very unfavorably located, and did not reach this amount.

F. C. E. writes:

Can any reader of Engineering News give me any record of the use of a packing for steam or water joints, pistons or other purposes, consisting of a lead or other soft metal core, covered with a layer of rubber?

J. B. M. inquires whether anyone can give any information as to an injurious effect upon wood of cement mortar placed in contact with it. He is told by several practical builders that the top of the foundation walls in a building should be laid in lime mortar, because the wooden floor beams which rest on these walls will soon decay if they rest on masonry laid in cement. He thinks that as lime has antiseptic properties, it may be possible that the practical builder's idea has a sound basis; and that the requirement that walls on which wooden beams are to rest should be covered with lime mortar may be a desirable addition to building specifications. We shall be pleased to hear from any of our readers who may be able to give information upon this matter.

THE RELATION OF MANUFACTURING WASTES TO THE SEWERAGE PROBLEM.

A paper on manufacturing wastes as related to sewage disposal was presented before the Civil Engineers' Club of Columbus, O., on May 21, by Mr. F. Herbert Snow, Assoc. M. Am. Soc. C. E., of the firm of Snow & Barbour, Boston and Columbus. The paper opened by pointing out the fact that stream pollution by manufacturing wastes is widely distributed throughout the country, manufactories being located on streams and other waters, and discharging their wastes directly into the adjacent water, whereas the domestic wastes from many small unsewered villages and towns reaches the water far less directly.

The question of nuisance is largely one of dilution. Mr. F. P. Stearns, M. Am. Soc. C. E., once fixed upon 0.0030 parts of albuminoid and 0.0399 of free ammonia per 100,000, as quantities below which nuisances had not been known to result, and 0.0233 parts of albuminoid and 0.1116 of free ammonia as limits above which nuisances would be created, the samples in each cases being those of water receiving sewage. Mr. Snow states that with the water receiving manufacturing rather than domestic wastes these limits may be exceeded, due partly to the more stable character of the impurities.

The available amount of dilution is governed by dry weather flows. Unfortunately the number of stream gagings so far made in Ohio is small. Rainfall records are much more extended. These show one very dry month each year, three dry months occasionally, and six dry months once in about twenty years. The lowest percentages of monthly rainfall available for stream flow on the Muskingum River, by single months, as shown by measurements of the U. S. Government, are as follows: December, 11%; January, 12; February, 13; March, 29; April, 31; May, 6; June, 6; July, 7; August, 3; September, 5; October, 5; November, 4. The stream flow in Eastern Ohio is more regular than in the balance of the State, where the surface evaporation is greater and the underground storage less. The relative flows in gallons per day per square mile for spring-fed, or Eastern, and prairie, or Western streams in Ohio, have been computed as follows:

	Streams,—	
	Spring-fed.	Prairie.
Driest month	5,800	5,800
" 2 months	23,200	8,700
" 3 "	33,100	9,900
" 4 "	31,900	12,800
" 5 "	38,300	15,100
" 6 "	42,400	22,100

These figures should be used with caution, and should be increased from 50 to 100% for ordinarily dry years, the increase depending on the size and character of the drainage area.

If no damage is done thereby to the sewers, it is proper to admit manufacturing wastes to the general sewerage system, provided also that these liquids do not interfere with the treatment of the other sewage, where treatment is employed. In some cases manufacturing wastes may require at least a preliminary treatment before going to the city sewers, and, generally speaking, the volume of such wastes should be kept down, although sometimes dilution will be an object.

Quite a portion of the paper was devoted to a digest of some of the experiments on purifying manufacturing wastes made during the past few years by the Massachusetts State Board of Health. As this digest may save some of our readers much time, we give it below, as follows:

Particular attention has been paid by the Massachusetts State Board of Health during the past few years to the purification of manufacturing wastes, such as those from paper making, wool scouring and tanning. These wastes usually contain a large amount of decomposable organic matter, and are more particularly noticeable in many cases for the special chemicals found in them, some of which aid in the decomposition, some of which are antiseptic and some germicidal. The study of sewage, therefore, which is abnormally influenced by manufacturing industries of the locality, involves a particular study of the nature of the output of these manufacturies.

Rags for paper-making are boiled in a solution of caustic soda or other alkaline liquid, and it has been found that the alkali of the waste effluent is so great as to make its nitrification difficult, and that purification by filtration is only possible when the waste is diluted by sewage or other dirty water.

Wool when removed from the sheep's back contains grease which must be removed before dyeing can be affected. This wool fat and wool grease, known together at "yolk," exists to such an extent that different wools lose from 15 to 75% by weight in passing through the washing process. The resulting effluent is accordingly heavily loaded with organic matter, and where sufficient alkali does not exist naturally in the wool to effect washing, some alkali is added to assist the process. There is some commercial value to the suspended matters of wool waste, and these are usually saved.

Experiments made in 1895 show that while strong wool-waste liquors can be somewhat purified by passing through sand, the extremely low rates possible—17,000 gallons per acre—make it advisable to remove a large part of the dirt and fatty matters before filtration. The removal of the fats can be accomplished either by the addition of sulphuric acid or of calcium chloride. Even with this removal the clarified liquor is rich in organic matters so stable in character that little change is effected by passing through sand, unless diluted.

It is also found that waste liquors from tanneries are with difficulty purified unless diluted, or treated before application to the sand. By the addition of lime some 60% of the organic matter can be precipitated, and experiments showed that the clarified liquor from the precipitation process could be purified by filtration.

In 1896 the study of manufacturing sewage was continued, special attention being given to the outflow from tanneries. In this year the nature of the waste was more closely differentiated, and an interesting development was found in the case of the effluent from the tannery handling calf-skins, which are shipped in sulpho-naphthol—a germicide. One of the processes in this same tannery involved the use of arsenic to remove the hair. This arsenic also being a germicide when existing in any amount, is incompatible with nitrification.

Studies were further made to remove the arsenic, and it was found that by passing the sewage through a strainer of coke breeze this could be effected. After the removal of the arsenic, bacterial development was found to be possible, and subsequent filtration of the effluent resulted in a fair degree of purification.

The effluent from other tanneries, owing to the nature of the output, contained no germicidal agents, and it was found that the effluent could with difficulty be purified. Precipitation of the sludge or heavier suspended matters was the most economical way of handling the heavy wastes, and by subsequently applying the clear liquor, diluted with town sewage, to sand beds, purification was readily effected, the necessary degree of mixing depending upon the original strength of the trade waste. In one experiment it was found that it was necessary to add 2½ parts of Lawrence sewage to one part of tannery waste in order to make purification possible.

In 1896, also, the investigation of paper-mill wastes was continued. In these wastes there are two classes—those produced in washing the stock and those produced in making paper; the first is more highly nitrogenous, the second carbonaceous. To these elements are added various chemicals and dyes.

It was found that by passing the liquor through sand or coke the principal effect was a straining process, whereby the carbonaceous matter and part of the dirt was removed and held at the surface of the filter. Nitrification, however, could be effected.

Continuing the experiments on treatment of waste liquors from rinsing and scalding wool showed that the heavy portions of the suspended matters must be removed in some other way than by filtration, on account of the rapid clogging of the surface of the filters, if this were not done. The experiments, therefore, were devoted mainly to the use of different chemicals to effect purification of these matters. It was found that the ordinary precipitates, such as lime and ferrous and aluminum sulphate, were of small value, and that calcium chlorate removed the fats, leaving a clear yellow liquid of slight odor. Although this liquid contained a large amount of organic matter in solution of such stable character that it could safely be permitted to enter a body of water not used as a water supply without the creation of a nuisance, its application to sand beds did not result in nitrification owing to its high alkalinity, and it was only when neutralized by acid and mixed with sewage that nitrification could be effected.

The necessity of special treatment of manufactural sewage is emphasized by referring to the amount of solids existing in some of these wastes. For instance, in the sewage from the calf-skin tanneries, the average solids per 100,000 parts was 932; as this tannery turns out from 20,000 to 300,000 gallons of sewage daily, there must issue from the works ten tons of solid matter. The solids in the wool-scouring liquids average 4,486 parts per 100,000, and although the quantity of waste is less than that from tanneries, the total solids thrown out each day is enormous. The same statement applies to paper mills.

Still greater importance was apparently attached to the study of manufactural sewage in 1897. Filters were established at different places in the state, and the study of tannery, paper-mill and wool-scouring liquor was continued.

The removal of arsenic by passing sewage through coke has been continued, and rapid filtration through a thin layer of coke, in order to remove and retain at the surface of the filter suspended matters of tannery wastes, has been successfully carried out. Nitrification, however, does not result to any extent, although the effluent is usually clear and of slight color. The effluent from tanneries, after sedimentation, has been applied to sand filters and purified. In all cases a mixture of manufactural and town sewage results advantageously in the increased degree of purification effected by the filters.

The experiments on paper-mill wastes were continued in 1897, and it was found that the strong alkaline liquor could not be purified by passage through sand, but that strainers of coke were successful in removing a large proportion of the total organic pollution from the wastes.

The conclusion that it is necessary to remove the heavier suspended matters from wool washings by chemical precipitation before application to the sand, is again borne out by the results of 1897.

As in many other manufactures, the necessity for differentiating the different wastes is apparent in that of the wool industry. For instance, the heavy scouring liquid is much more polluted than that resulting from the washing of the wool. The sludge of the heavy scouring liquid was again removed by the application of calcium chloride. The effluent from this process could be passed through sand, but little nitrification resulted until diluted by town sewage. In most cases it was necessary to neutralize with acid before application to the beds. It was found that in proportion of one part of wool liquor to five parts Lawrence sewage a high degree of nitrification could be obtained in the effluent.

Finally, summing up what is known about the treatment of manufacturing wastes, it may be said that without exception treated wastes can be purified. In some cases to effect this it is necessary to dilute the treated waste with town sewage, in order to make nitrification possible. In many cases it is necessary to remove the heavier suspended matters before applying the effluent to the filter. Sometimes the matters so removed have a commercial value, which leads the manufacturer to save these wastes.

In some cases the nature of the waste is such that its entrance into the sewers cannot safely be permitted, on account of the probability of its lodgment before reaching its final destination. In short, the worst trade wastes in most cases make necessary a special treatment by the manufacturer before permitting their entrance to the general system of sewerage.

The use of water for manufacturing purposes is so great as to materially increase the cost of sewerage systems to which it is admitted. It is also true that from certain points of view manufacturers should be held rigidly accountable for all stream pollution, or should take measures to prevent it. At the same time it must be remembered that the whole life of some sections of the country depends upon manufacturing industries, and that for many years they have been allowed great latitude in their methods of waste disposal. Sudden prohibition of stream pollution might result in great hardship or possible business embarrassment. Pollution endangering human life must be dealt with summarily, but at the other extreme there are some forms of pollution only slightly objectionable to the eye, for instance, which may be tolerated.

The apportionment of the cost of disposing of manufacturing wastes, when done by municipalities, is likely to be a difficult matter, especially in view of the general lack of scientific adjustment heretofore prevalent. It is sometimes urged that a large manufactory contributes so much to the well-being of a city that some, or all, of the expenses of its sewage disposal should be borne by the city as a whole. But there may be other manufacturers making far less use of the sewers, relatively, in which case it would be manifestly unfair to let the large users of the sewers go practically free from special assessments. In general, the principle that the cost of public works should be proportioned in accordance with the benefits received is true here, but may be difficult of application. Cases may arise where the removal of manufacturing wastes from a stream would be of immense benefit to the whole community, and where the burden involved would cripple the industry creating the wastes. If at the same time the stream in question has been receiving the wastes for many years, it may be advisable to put part or all the cost on the community. The sewer assessment laws of Ohio should be modified so that "any community can by popular vote choose the method of apportionment that seems to be best adapted to its peculiar wants."

NOTES FROM THE ENGINEERING SCHOOLS.

University of Wisconsin.—The college of mechanics and engineering of this university has just issued a circular briefly outlining the graduate course of study in electrical engineering. Copies of the circular and further information can be obtained from D. C. Jackson, Professor of Electrical Engineering, Madison, Wis.

Purdue University.—Several students in the electrical engineering course have been experimenting with wireless telegraphy, and recently succeeded in transmitting messages a distance of two miles across the city of Lafayette, Ind.

University of Birmingham (England).—Recently Mr. Andrew Carnegie gave $250,000 to a sum which Mr. Joseph Chamberlain has been trying to raise for this university. Mr. Carnegie's contribution was given with the proviso that the scientific school be made the principal department in the institution. He points out the great need in England of young scientific experts, and urges Mr. Chamberlain to take Cornell University as the model for the Birmingham Engineering School.

Mr. Carnegie's generous gift has, it is understood, been accepted by the university authorities.

University of Maine.—The department of chemistry has recently received an addition to its equipment in the form of a number of valuable instruments and pieces of chemical apparatus.

Improvements are being made about the campus, and recently between 1,500 and 1,600 trees and shrubs have been planted.

University of Illinois.—A circular just received from W. L. Pillsbury, Registrar, states that the university includes 15 buildings, has 214 instructors, and offers 375 courses of instruction. The attendance for 1896-7 was 1,075; for 1897-8, 1,585, and for 1898-9 it is 1,750.

Cornell University.—According to a card just received from Dr. R. H. Thurston, Director of Sibley College, the following are the regulations of the engineering school of this university:

Rules Governing Students in Sibley College, Cornell University.—Formulated under the statutes of the University, which provide that the director shall control the "whole working" of Sibley College.

(1) Every student in Sibley College is expected to show himself a gentleman, at all times, within or without the precincts of the college.*

(2) Every gentleman attending Sibley College is expected to be a student.

*Gentleman.—A man of good breeding, courtesy and kindness; hence a man distinguished for fine sense of honor, strict regard for his obligations and consideration for the rights and feelings of others.—Century Dictionary.

The New York State College of Forestry, which was recently established under the direction of this University, has planted so far this spring 50 acres of Adirondack burned land with white pine and other conifers. The work was performed by wood choppers, who had during the preceding winter felled 3,000,000 spruce trees. A nursery has also been started which, inside of two years, will furnish 3,000,000 seedlings, or enough to plant 2,500 acres. The intention is to plant each year fully 500 acres, which can be done, according to Director Fernow, for about $3 per acre.

ROAD BUILDING IN PORTO RICO, under Major Francis L. Hills, M. Am. Soc. C. E., Director of Public Works at San Juan, is now employing about 15,000 men, according to that officer's last report to the Secretary of the Interior. Major Hills, who is a graduate of West Point, and an ex-officer of the 3d Artillery, has thoroughly systematized his work, and at the date of his report, April 29, 62 roads were being rebuilt or repaired. The men are divided into gangs of 25, with a foreman to each gang, and superintendents over the section. The whole island has been divided into two roadbuilding districts, and the man are paid 50 centavos for 8 hours' work, with payments twice per month. The construction is intended to be permanent; the roads are carefully graded, ditched and macadamized; and the roads selected are those which will serve as main arteries for communication between the interior and the seacoast. During the month of April 195,000 pesos were taken from customs receipts and expended on roads. Gen. Guy V. Henry, in leaving the department, wrote a letter to Major Hills thanking him for the important work done in road construction, and in the useful employment of large bodies of men.

ALASKAN SAILING CHARTS have been published in Bulletins Nos. 37 and 38 of the U. S. Coast and Geodetic Survey. These cover the late work of Lieut.-Commander J. F. Moser, U. S. N., and relate to portions of Alaska, from Dixon Entrance to Yakutat Bay, and the vicinity of Prince William Sound, Cook Inlet, Kadiak Island, and route from Unalaska to Chignik, through Unimak Pass and inside the islands. The surveys were made by the "Albatross" in 1897, and the bulletins include full hydrographic notes, sailing directions and land contours.

THE 39TH PARALLEL TRIANGULATION, by the U. S. Coast and Geodetic Survey, is completed and the detailed results of the survey will shortly be published in a large quarto volume. The total distance across the continent on this parallel is about 2,625 miles, and this distance is fixed within an error of 100 ft., or less than ½-in. per mile. This survey has been in progress for nearly 50 years, and a basis is now provided for an accurate survey of the whole country.

THE WELL-KNOWN WURDEMAN DIVIDING ENgine, made by Mr. William Wurdeman, for many years chief mechanician of the U. S. Coast Survey, at Washington, D. C., has been purchased by C. L. Berger & Sons, successors to Buff & Berger, of Boston, Mass. This is an automatic circle dividing engine, and it engraves the graduation circle of an instrument to five seconds of arc, within a limit of error of "less than one second." What this means is better understood by stating that if the circle had a diameter of ten miles, one second of arc would be equivalent to one inch. An electric motor operates the engine.

ALUMINUM FOR ELECTRICAL CONDUCTORS is coming into extensive use. The recent increase in the price of copper has made aluminum considerably cheaper for line conductors of equal electrical resistance. Aluminum wire is now drawn so as to be equal in strength to pure copper, and the saving in weight is an important advantage. It has recently been made use of for a power transmission plant on the Pacific coast, 12 miles in length.

A PORTABLE ELECTRIC POWER or lighting plant has been patented in France by Albert Collet. This plant is arranged on a two-wheeled barrow, and weighs about 1,000 lbs. in working order. It is intended to supply power for contractors for railways, or for repairs; to bore holes in railway ties, to tighten nuts along the track, and to operate any small tool; it will also feed 4 to 6 arc lights or 30 to 40 incandescent lights. The plant includes a petroleum motor, generating dynamo, water and petroleum tanks, and current-wires to the tool. The petroleum motor is about 4 HP., and of the type employed in automobiles. When used on a railway, the whole plant is placed on a small truck, that can be easily lifted on or off the track. It has already been utilized for providing light in tunnel repairs, and at small railway stations where there is some exceptional night traffic.

THE NEW YORK COMMERCE COMMISSION, appointed by ex-Governor Black to investigate the condition of New York's commerce, is to resume its public hearings, which were temporarily stopped pending the passage of a bill defining its powers. This bill has now been passed and signed by Governor Roosevelt. The new bill largely increases the power of the commission, and permits it to take a more comprehensive course in examining into the causes of the decline of commerce at this port, and the means for its revival. The Commissioners are: Charles A. Schieren, chairman, Hugh Kelly, A. R. Smith, Andrew H. Green and C. C. Shayne. Mr. B. L. Fairchild is counsel for the commission.

A NEW FORM OF CERAMIC DECORATION, for buildings, has been patented by M. Siever, of Paris. A skeleton of wire mesh is first dipped into a paste made of silica, sand, kaolin and fluor-spar, with coloring oxides added. On this skeleton or foundation the ornamental detail is modeled with the same composition and then baked. The placque or other object is then enameled and rebaked. The chief advantages claimed for this construction are lightness, relatively large areas in single pieces, strength, durability and comparatively small cost. It is proposed to use the new product for the exterior and interior decoration of buildings.

THE RUSSIAN CALENDAR, now about 12 days behind that of other nations, may be changed to conform with these others. A commission has been appointed to discuss the matter, and it is now in session in St. Petersburg. The trouble arises from Russia sticking to the erroneous Julian calendar, though Great Britain only changed to the Gregorian calendar in 1752, about 170 years after France, Spain and Italy had adopted the new style. The strongest opposition to the reform in Russia comes from the clergy of the Greek Church, with its ecclesiastical observances founded upon the old-time calendar.

DENSITY OF POPULATION in Provinces of China, as compared with States in our own country about equal in area, is set forth in the form of a table issued by the U. S. Bureau of Statistics. The Province of Hupeh, for example, with its area of 70,450 sq. miles, is compared with the 76,670 sq. miles of Ohio and Indiana combined; but Hupeh has a population of 33,365,005, as compared with 5,864,720 for these two states. Honau is nearly equal to Missouri in size, but has 22,115,827 inhabitants as compared with 2,679,184. Fuhkien has 38,480 sq. miles, and 23,000,000 people; Ohio has 40,760 sq. miles and 3,672,316 people. The Province of Shantung has 65,104 sq. miles, or a little more than 62,000 sq. miles of all New England; but in population these areas compare as 36,248,000 to 4,700,945. The Province of Szechuan has 166,000 sq. miles, or a little less than the 173,430 sq. miles of Ohio, Indiana, Illinois and Kentucky combined; but this Chinese Province has 67,712,697 inhabitants, against 11,350,269 for the States named.

DISINFECTION OF DEAD HORSES IN THE JUMBO mine, in Athens Co., O., is thus described in the 23d annual report of Mr. Robert M. Haseltine, the chief inspector of mines for Ohio: As the result of a fire in this mine in December, 1896, 32 horses were smothered, and the bodies were inaccessible until March, 1897. The question of avoiding the consequences of inhaling the resultant unpleasant odors was submitted to Dr. C. O. Probst, of the State Board of Health, and he finally recommended as a disinfectant a solution of chloride of lime, with 6 or 8 ozs. to one gallon of water. This was applied to the carcasses by the bucketful, and after one-half hour the bodies were turned by long hooks and the other side similarly treated. In 15 minutes time the bodies were loaded on a stretcher and then on a mine car and sent to the outside without emitting any disagreeable odor. Outside the bodies were placed on a large pile of wood, covered with coal slack and burned. At 6 to 8 cts. per pound for the chloride of lime, and one-half bucket of chloride used to one barrel of water, sufficient of the fluid was made to disinfect two or three horses at a cost averaging 15 to 25 cents.

PLANS FOR THE SIX NEW CRUISERS have been agreed upon by the Board of Naval Bureau Chiefs. These ships, the "Denver," "Des Moines," "Chattanooga," "Galveston," "Tacoma" and "Cleveland," will each have a displacement of 3,400 tons ready for sea; and they will be sheathed with copper. The speed is fixed at 16½ knots, with a coal-bunker capacity sufficient for a cruise of 2,800 miles, or 6,925 miles at a 10-knot speed. Water-tube boilers will furnish steam for twin-screw engines of 4,500 HP. each. These are the only vessels that can be commenced this year, of those provided for in the last Naval Appropriation bill, owing to the inability of the Department to secure armor for the other ships.

COMPRESSED-AIR CARS are suggested for certain lines in Chicago, and the Compressed Air Motor Co., of Chicago, is operating a car on the North Clark St. cable line, as a substitute for the horse cars which are run after midnight, when the cable plant is shut down for inspection. The company is also building an air-motor truck for use on a 60-ft. passenger car, suitable for suburban survice on steam railways. This car is to be tried on one of the railways leading out of Chicago. It will have sufficient storage capacity for a round trip of 25 miles at the average speed of suburban trains, hauling one extra passenger car as a trailer. The mechanism is on the Hardie system, which, as applied to an experimental locomotive for the New York elevated railway, was described in our issue of June 24, 1897. Particulars of service of street cars on this system, in New York, were given in our issue of Oct. 7, 1897.

LOCOMOTIVES OF THE ATLANTIC TYPE for heavy express service are being built by the Lancashire & Yorkshire Ry. (England) to the designs of Mr. Aspinall, Locomotive Superintendent. They are of most peculiar appearance, as in order to clear the crank axles the boiler is pitched so high that its top is level with the roof of the cab, and this necessitates a little, dumpy smokestack, which seems to have no relation to the boiler. It is, in fact, smaller than the very small dome. The engine has the following leading dimensions:

Driving wheels	7 ft. 3 ins.
Truck wheels	3 " 0½ "
Trailing wheels	3 " 7¾ "
Wheelbase, driving	7 " 6 "
" total	27 " 9 "
Weight on driving wheels	78,400 lbs.
" total engine	131,600 "
" of tender, loaded	68,684 "
Cylinders	19 x 26 ins.
Boiler, diameter	4 ft. 10 "
Firebox	89 x 39 "
Tubes, 239; diam.	2 "
" length	15 ft. 0 "
Heating surface, tubes	1,877 sq. ft.
" " total	2,053 " "
Grate area	26 " "
Capacity of tank	2,200 gallons.

TANK LOCOMOTIVES are extensively used in South Africa, and some heavy tank engines have recently been built by Beyer, Peacock & Co., of Manchester, England, for the Pretoria & Pietersburg Ry., in the Transvaal.

This road has a gage of 3 ft. 6 ins., with grades of 2% and curves of 490 ft. radius. The conditions of the design called for train loads of 212 tons, axle loads not exceeding 26,432 lbs., a speed of 25 miles per hour, and a capacity for 1,540 gallons of water and 3 tons of coal. The engines have outside cylinders, Walschaert valve gear, Belpaire (copper) fireboxes, brass tubes, plate frames, side tanks and enclosed cabs. They have six coupled driving wheels, a two-wheel leading truck, and a four-wheel trailing truck. The leading dimensions are as follows:

Driving wheels	3 ft. 10 ins.
Truck wheels, leading	2 " 6 "
Wheelbase, driving	10 " 2 "
" total	28 " 3½ "
Weight on driving wheels	77,896 lbs.
" total	127,624 "
Boiler, diameter	4 ft. 1⅜ ins.
Working pressure	170 lbs.
Firebox	86 × 29⅛ ins.
Tubes, 185; diam.	1¾ "
" length	10 ft. 0 "
Heating surface, tubes	873.4 sq. ft.
" " total	970.4 " "
Grate area	16.9 " "

ANNUAL CONVENTION OF THE AMERICAN WATER-WORKS ASSOCIATION.

The nineteenth annual convention of the association was held at Columbus, O., May 16 to 19, inclusive. The President, Mr. J. A. Bond, not being able to attend, the chair was occupied by Mr. Wm. R. Hill, M. Am. Soc. C. E., part of the time, and by Mr. John B. Heim during the balance. After the usual preliminaries the reading of papers was begun.

"How the Water Supply of Syracuse is Kept Free From An Unpleasant Taste."

By Wm. R. Hill, M. Am. Soc. C. E., Syracuse, N. Y.

In the latter part of May, 1896, the water from Skaneateles Lake tasted so badly that it became necessary to supply the city directly from the lake, instead of passing the water to and through the distributing reservoir. By way of explanation of the conditions affecting the supply, it may be stated that Skaneateles Lake has an area of 12¾ sq. miles; a maximum depth of 350 ft.; shaly banks; no swampy margins; and a drainage area, exclusive of water surface, of 60.3 sq. miles. The water is taken from a depth of 40 ft. below the surface through 1¼ miles of 54-in. steel intake pipe. The water passes through a screen of 1-in. mesh at the intake crib and through another of ¼-in. mesh, at the gate house.*

The supply main between the lake and the reservoir is 19¼ miles long, of 30-in. cast-iron. The crest of the dam at the lake is 245 ft. above the flow line of the reservoir. The reservoir has an area of 14 acres and a capacity of 121,000,000 gallons with the water 35 ft. deep. The bottom and lower part of the slopes are concreted, and the upper part of the slopes is paved with stone.

The water from the lake was first used on June 29, 1894. From that date until Sept. 21, 1894, an old distributing reservoir, with a puddled bottom, was used. This reservoir was then cut out and the city supplied directly from the lake until July 23, 1895, when the surplus flow, above the daily consumption, was turned into the new reservoir. About the middle of August, 1895, the reservoir was filled, and after that time the city was supplied from it.

The water contains only a small amount of organic matter. The balance of Mr. Hill's paper is as follows:

About the middle of May, 1896, a complaint was received at the office of the water department that the water tasted badly. Upon examination but a very slightly unpleasant taste could be detected. After that the complaints became more frequent, as the water was becoming more and more disagreeable. On May 20 it was very unpleasant to drink on account of the strong fishy taste and disagreeable odor. On this date the water in the reservoir had attained a temperature of 57°F., for the first time that season. The water entering the reservoir from the lake was 10° cooler, and was perfectly free from any unpleasant taste. This water was immediately turned into the distributing system, and the supply from the reservoir was shut off. The distributing system was emptied of the disagreeable water by opening the hydrants on the outskirts of the city, and in a few hours the people were supplied with a good, potable water.

The reservoir was then emptied, the disagreeable odor increasing as the water was lowered. In the bottom of the reservoir at the foot of the slope a dark green gelatinous substance was found. When this was partly uncovered of water it broke apart, and the edges curled up, disclosing that the underside was a dark maroon color. It was from ⅛ to ¼-in. in thickness, and the stench from it was almost unbearable. The reservoir was cleaned and refilled with water on July 10, 1896, after which the city was supplied from it, and no further trouble was experienced that season.

During the spring of 1897 the water in the reservoir was very carefully watched, both as to its odor and appearance. About the first of June, fine black specks were noticed floating in places near the shore. Upon close examination (without the aid of a microscope), these particles were found to have the appearance of very small flies. Although at first they were very few, still they were thoroughly skimmed off. After that they were found and removed each day.

A few days after their first appearance, a very fine, dry, yellow substance about the color and appearance of yellow corn meal was seen floating upon the surface of the water. This, like the dark particles, although developed over the entire area of the reservoir, soon floated close to the shore. The greater portion of the yellow substance formed into little balls as it was being carried to the shore. These balls could be easily skimmed off by a skimmer made of cheese cloth, but the separate particles were so fine that they would pass through the cloth, and in order to remove them it was necessary to use a tin vessel. There was no odor from them when first developed, but in less than 24 hours after they were skimmed off, they would decompose and have a very strong odor similar to that of decayed fish.

During the summers of 1897 and 1898, both substances have appeared, and have been removed from the surface of the water every day from about the middle of May until the first of September, the greater quantity from the first of June until the middle of July. They were found most abundant after a warm night, when about enough to fill a peck measure would be taken off. A slight breeze would carry them to the shore, as they were very light and floated upon the surface of the water. They were skimmed off each day, the work ordinarily requiring the services of one man; but on a few occasions when there was scarcely any breeze, it has required the work of six men.

They are spore and algae organisms, and are so minute that they are passed unnoticed by casual observers. They will not contaminate the water if they are removed before decomposition takes place; neither will the gelatinous substance form in the bottom of the reservoir. Not the slightest taste or odor to the water has been detected during the past two summers. Although the water in the lake reaches at times a temperature of 80°F., still these organisms do not develop in it. It may be that they are consumed or otherwise destroyed in the lake by other organisms, which cannot exist in the reservoir because of the cement lining.

In conclusion, I would recommend that all visible vegetable or animal organisms, foam, scum or any other foreign substance be removed as soon as possible from any water that is used for domestic purposes.

*See Eng. News, June 15, 1893, for a description of the intake, and Dec. 13, 1894, for a description of the supply main.—Ed.

"Some Difficulties in Obtaining a Water Supply."

By W. J. Milner, Birmingham, Ala.

This paper related to the development of the water supply of Birmingham, Ala., and covered much the same ground as a lengthy illustrated article which appeared in Engineering News for April 16, 1892. Since the date named a new pump, force main, stand-pipe and reservoir have been added. The reservoir has a capacity of 110,000,000 gallons, and the stand-pipe is 6 × 55 ft., being a mere regulator of pressure. The mechanical pressure regulating device described in the article named is not used now. A few facts from the paper are as follows: Birmingham is a city of rapid growth, located on the side of a mountain. The water supply is from surface sources, and is of excellent quality, except for occasional turbidity. Formerly a polluted supply was used, and the typhoid death rate was high, being given in Prof. Mason's "Water Supply" (p. 41) at 26.4 per 10,000. In 1898 the rate was about 2 per 10,000. Of the ten deaths from typhoid in 1898, two were cases brought into the city, and only five of the eight other cases used the public supply.

The company succeeded last year in defeating an attempt on the part of the city to reduce the rates. The city repealed all ordinances for the protection of the company and passed one establishing lower rates. It also passed one providing that any officer of a company attempting to collect rates above those in the new ordinance should be liable to a fine of $100 in each case. The court declared the ordinance invalid. The company's franchise does not stipulate the amount of water to which consumers are entitled under the domestic rates. The company has 4,400 services, 600 of which are metered. The meter rates range from 8 to 30 cts. per 1,000 gallons, with some special contracts at less than 4 cts. The company, under the contract, furnishes, sets and repairs meters and charges a meter rental, which for a ½-in. meter is 25 cts. per month.

"A Brief Account of the Water-Works of Columbus, O."

By Julian Griggs, City Engineer.

Construction of these works was started in 1870, the supply then being from a well on the bank of the Olentongy River, with an emergency river intake. There was talk at the outset of using Clark's process for softening water. The yield of this well soon became insufficient, and a filtering gallery was built. This has been extended from time to time until it now includes 9,296 ft. of brick-lined gallery and 3,350 ft. of 42-in. perforated cast-iron pipe (see Engineering News, April 2, 1896, Nov. 25 and Dec. 16, 1897). Besides the conduit, a filter basin has been used and two series of driven wells have been put down. Temperature observations indicate that the water from the filter gallery does not come directly from the river. The average daily water consumption from all sources is about 15,000,000 gallons.

During the last two or three years plans have been made for a dam across the Scioto River, and $175,000 bonds have been voted for it and other improvements. Mr. Allen Hazen, Assoc. M. Am. Soc. C. E., of New York, was consulted by the State Board of Health regarding the change in supply. He recommended that the dam be made 52 instead of 32 ft. high, and that the water be filtered. Mr. Jas. D. Schuyler, M. Am. Soc. C. E., of Los Angeles, Cal., has also recommended that the dam be made 52 ft. high, at the start or ultimately. Bids for building the dam to the 32-ft. level were received a few months ago, but the project has been delayed by taking some legal questions into the courts.

Quite a discussion on meter rates followed the reading of the paper. Mr. Griggs and Mr. Jerry O'Shaughnessy, of Columbus, gave the following information regarding meter rates in Columbus: A few years ago advantage was taken of the fact that the Pennsylvania Railroad was receiving water (but in large quantities) at 6 cts. per 1,000 gallons to start an agitation for the same rate to all consumers, regardless of quantity. Suit being brought by a consumer, the Court of Common Pleas held that all consumers must be furnished water at a uniform price. Instead of advancing the price to large consumers the rate was lowered to 6 cts. for all. There is no minimum yearly rate for all water furnished. One consumer complained, a while ago, that the water supplied to him contained iron rust. The records showed that for the preceding six months he had used only 1,500 gallons of water, or 9 cts. worth. The suit above mentioned was never carried above the lowest court. Other cities in the state have sliding meter rates, and minimum charges for yearly bills. To an outsider it appears that the city officials of Columbus have suffered this ruinous business policy to continue for fear of making themselves unpopular by testing the matter in the courts or advancing the meter rates.

Mr. Geo. Hornung, of Newport, Ky., stated that his city had recently been advised by its attorney that it could not legally charge a minimum rate or maintain a sliding scale.

Mr. C. H. Campbell, of Charlotte, N.C., said a court had decided that the Goldsboro (N. C.) Water Co. could not have a sliding meter rate, but this was due to a provision in the company's franchise. He also said that his city, Charlotte, N. C., had recently secured legislative authority to establish rates, as it sees fit. The rates have been fixed at from 10 to 25 cts. per 1,000 gallons. The Water Department lays service connections to the curb and sets a meter at the curb, charging for all labor, pipe, meter, meter box, stop cock and box, only $18.50 for a ⅝-in. connection and meter. Some of the members thought this financially impossible, but the speaker said the actual cost did not exceed that sum. The streets, however, are narrow, the trenches only 20 ins. deep and labor $1 a day. The streets are macadamized. The universal meter system has been adopted. A minimum yearly charge of $7.80 is made for metered water. Another speaker cited a case where both the common and circuit court held that a water company could not charge a minimum rate of $5 a year, but that a sliding scale was legal.

"Thawing Frozen Water Pipes by Electricity."

By John B. Heim, Madison, Wis.

This paper covered the same general ground as the article in Engineering News for March 23, 1899, and in addition gave some details of experience and cost. At Madison it was thought that the pipes were all below the frost line, being 5 ft. deep, but during the severe weather of last winter the water in some 400 services and a 4-in. main froze. One service defied the attempts of the plumbers to thaw it, and attracted the attention of Prof. Wood, who consulted with Prof. D. C. Jackson. The electric thawing system was then devised. Since then at least 50 cities in Wisconsin and adjoining States have availed themselves of the courtesies extended by Professors Jackson and Wood and the University of Wisconsin, and applied for information. A number requested aid in putting the system in operation. The average cost of thawing 101 services in Madison was $5.55. In Rockford, Ill., about 100 were thawed at an average cost of $4.80 each. At Iron Mountain, Mich., 900 ft. of 2-in. pipe was thawed in 300 ft. sections, and also 250 ft. of 4-in. main, the latter in 2½ hours. The need for some improved means of thawing service pipes, Mr. Heim stated, is shown by insurance statements to the effect that in 1898 no less than $100,000 of fire losses were paid on account of the use of primitive methods for doing such work.

A vote of thanks was extended to Professors Jackson and Wood for turning over this system of pipe thawing to the world.

"Thoughts by the Way."

By Peter Milne, New York city.

This was a brief paper, pointing out the benefits of membership in the association and urging co-operation to carry out its objects.

"Views of Constructed Filtration Plants."

By Allen Hazen, Assoc. M. Am. Soc. C. E., New York City.

A series of very interesting lantern slides were shown and explained by Mr. Hazen, including foreign plants, the works at Albany now being built by Mr. Hazen and views of a small plant for an institution near Harrisburg, Pa.

"The Flow of Water Through Valves."

By Prof. Wm. T. Magruder, M. Am. Soc. M. E., Columbus, O.

This was an interesting study of the comparative flow of water through gate, globe and angle valves, and of the effect of each on pressure. The study was based on a graduating thesis prepared under the direction of Professor Magruder in 1897 by C. W. Damron and Horace Judd, of the course in mechanical engineering. The tests covered several makes, six different pressures and five small sizes of valves, the sizes all being such as are used in service pipes. An enlarged section of a globe valve was used to show that there are eleven places in this kind of valve where there is a frictional loss. In all three classes the water passage has an area of only 71 to 78% that of the pipe of the same nominal size. The

rate of flow through gate and angle valves was found to be 2 and 1¼ times, respectively, that through globe valves. It was also found that the quantity discharged through a valve increases proportionately with the cost. It is advisable to use a valve one size larger than that of the pipe. The small and poorly designed valves and fixtures used on the services of some water-works systems necessitate from 40 to 80 lbs. more pressure at the pumping station than would be necessary if proper valves and fixtures were used. The manufacturers would do well to provide a 1-in. valve with connections for ¾-in. pipe, and so on for other sizes. In answer to a question, Professor Magruder said a swing check valve would probably have an efficiency of about 65% of the theoretical flow of the same size of pipe, while a plain horizontal check valve might go down to 25 or 20%. Mr. C. Monjeau, of Middletown, O., said that he had recently used valves throughout a whole water-works system 1 in. greater than the mains, with evident reduction in the amount of steam used for pumping.

"An Outline of the Present Status of Water Purification."

By Geo. B. Fuller, Cincinnati, O.

Data are now in hand regarding purification works supplying a total of 25,000,000 people, mostly abroad. Where applicable, slow sand filtration is the best and cheapest system. With turbid waters, sedimentation, coagulation, or mechanical filtration, may be necessary. With very turbid water, slow sand filtration fails because it does not clarify the water, or remove all the bacteria, and also because the dirt penetrates the sand so far as to make cleaning by scraping insufficient. That the use of chemicals is undesirable is undoubtedly true; but some times it cannot be helped. Decomposed sulphate of alumina is harmless and undecomposed inadmissible and unnecessary. After referring to the main portion of the Cincinnati experiments, outlined in Engineering News of Dec. 8, 1898, and March 9, 1899, Mr. Fuller gave an account of some later tests with a new lime process, as follows:

Very recently there was investigated at Cincinnati a new process of purifying clay-bearing water after the general method of the American system of purification. As this subject has not yet been reported upon, I am not at liberty to speak of the detailed information obtained from it, but in brief and general terms the procedures may be outlined as follows:

This purification plant, which was constructed and operated by the Ohio Sanitary Engineering Co., at its own expense, was tested officially by the city of Cincinnati for 42 days, from March 13 to April 25, 1899. The process in its original form consisted essentially of three principal steps, as follows:

(1) The treatment of the original river water with lime water.

(2) The precipitation of the coarser particles in the water after the lime treatment.

(3) The rapid filtration of the partially clarified and thoroughly coagulated effluent from the precipitation tank.

With regard to the action of the applied lime water upon the particular river water, it may be stated that it produced coagulation, and the bacteria and clay particles were aggregated into relatively large masses, thus facilitating rapid precipitation and rapid filtration. To accomplish this result with the river water in question, it was found to be necessary to apply lime water in sufficient quantities to combine with the free and half-bound carbonic acid of the water, and also to afford a sufficient excess of lime water to produce the coagulation. Whether or not it would be necessary to use an excess of lime water in the treatment of all waters by this process, was not brought out during these tests, although it is said that this would not be the case with water of more favorable composition.

The precipitation tank was operated on the continuous displacement plan, and the period of subsidence was twelve hours, which was found to be adequate when the river water was in its worse condition. With a suitable quantity of applied lime water, adequate to the character of the river water under treatment, the effluent from the precipitation tank was well clarified in consequence of the thorough coagulation. By virtue of this coagulation the small percentage of bacteria and suspended matter which passed through the precipitation tank were well prepared for satisfactory removal by rapid filtration through a sand filter. The sand filter was equipped with mechanical appliances to assist in cleaning.

These devices, aided largely by the clearness of the applied water, caused the amount of wash water required to be a very low percentage of the water treated. Under efficient management, which is of course necessary for all systems of water purification, the effluent of the sand filter was perfectly clear in appearance, and very low in its contents of organic matter and bacteria.

Concerning the excess of lime water which was used during the test, for reasons already explained, it may be stated that it passed through the system and appeared in the effluent of the sand filter in a practically undiminished quantity. The presence in the effluent of the sand filter of lime water in excess in such quantities as were used during these tests is inadmissible for a number of reasons, and it is necessary to remove it in order to obtain an effluent of satisfactory character.

On large scale it is said that this would be accomplished by the application of carbonic acid obtained from lime kiln gases from limestone burnt at the plant, and the subsequent removal of the carbonate of lime formed therewith. During this test, however, the action of the gas was demonstrated by the use of carbonic acid, obtained and applied in a liquefied form.

For reasons already mentioned, comparative statements as to its efficiency and economy must be deferred for the present.

Unfortunately the session stampeded to see some fire streams thrown without giving an opportunity to discuss this paper. A sudden adjournment was also taken after Mr. Hazen's talk at an earlier session. This was all the more to be regretted since there were a number present who especially desired to hear or take part in the discussion.

"The Duty of the State in Protecting Sources of Public Water Supply."

By Dr. C. O. Probst, Columbus, O.

An eminent state health official once said that the function of the state in health matters is to teach people how to discriminate, point out dangers, suggest remedies and leave the people to carry out the latter. If water is purified it is important to have it as pure as possible to begin with, on account of the danger from frozen sand filter beds, or the scant use of alum in the case of mechanical filtration.

Can a stream which has received the effluent from sewage purification works be used subsequently as a source of public water supply? In considering this question too much weight should not be given to such ideal results as are reported from the Framingham sewage filter beds. It must also be remembered that there are other sources of pollution than city sewage. The answer to the question just asked must depend largely upon local conditions. It is certain that no unpurified sewage should be discharged above the source of a public water supply.

Interstate action is needed to prevent stream pollution. The Federal government should take it up, but, to its shame, it ignores all requests to that end. Each state should prohibit the pollution of water supplies by sewage. In 1893 the legislature of Ohio gave the State Board of Health some control over water supply and sewage disposal. All plans for these purposes must be submitted to the board for its approval. There is no penalty for failing to do this, but the State Attorney says an injunction could be secured to prevent construction of works without such approval. Since the act was passed, 42 plans for sewerage and water supply have been passed on by the board. There are now in the State of Ohio 13 sewage purification plants for municipalities or public institutions. In 1897 the board was directed to make a study of the streams of the state, and it has issued a special report on the subject, taking up stream flow, pollution shown by visual inspection, chemical and bacterial analyses. In an attempt to bring the work before the people the report was sent to water-works authorities drawing water from polluted streams and to the corresponding health authorities. Already a few communities have taken steps to remedy defects pointed out in the report. In 1898 the legislature directed the board to report yearly on all the public water supplies in the state. It has sent an engineer to all works using surface water, and he has inspected for pollution within ten miles of the intake (the limit of jurisdiction of a municipality on account of its water supply). The engineer also collects other information on water supplies, including the provisions of franchises of private water companies relating to the quality of the supply to be furnished.

This paper was followed by quite an extended discussion.

Mr. Robert S. Weston, of Boston, thought the state legislatures would soon prohibit pollution, especially in view of such conditions as had developed in the cases of the Merrimac, Passaic and Schuylkill rivers. Mr. L. E. Chapin suggested that the Ohio statutes be amended to make the approval of the State Board of Health a necessity to the legality of bond issues for water supply and sewerage. Bond buyers are the closest scrutinizers of all the points involved in legality of public works.

Mr. H. C. Hodgkins urged that too often communities go to the State Board of Health to satisfy the law, instead of because of a desire to secure or perfect water supplies. For 15 years the Province of Ontario has had a law similar to the Ohio acts under discussion, and experience under it has shown the necessity of a penalty clause for non-fulfillment. Injunction proceedings may cause large expenses, and the bills thus incurred may be audited and may not. Health boards should have ample funds, both for investigations and legal expenses. The Ontario board is handicapped by lack of funds, and sometimes seems to show it by failing to secure the best engineering advice in passing on plans laid before it. These and other reflections suggest the desirability of dual water supplies, in order to simplify matters. Mr. F. H. Snow, Assoc. M. Am Soc. C. E., of Boston, said municipalities are unable to cope with stream pollution. Our only hope is state control. From the earliest times streams have been dedicated to the use of riparian owners, some of whom have, to a certain extent, acquired a license to use streams as they see fit. Too rapid changes in these particulars may be disastrous to industries.

"An Object Lesson."

By Chas. E. Bolling, Richmond, Va.

The beneficial results of metering a part of the services at Richmond, Va., were shown in this paper. The water consumption of the city increased from 45 gallons per capita in 1870 to 92 in 1880, and 168 in 1890. Later it became a question of spending $270,000 for new pumps and mains or putting in meters. In the spring of 1897 the sum of $15,000 was voted for meters, to be set at Mr. Bolling's discretion. The meters were placed on the lower levels of the intermediate service, largely in houses having only two fixtures, as sink and water closet, but having, in some cases, a monthly use and waste of 30,000 gallons a house. In all, 1,204 meters were set in 1897. These were followed by 1,172 in 1898. The results have been: Large increases of pressure; reduction of per capita consumption to 99 gallons for 1898; a total consumption for 1898 some 27% less than that for 1890; and the shutting down of a steam pump for the past 18 months, with a consequent reduction in operating expenses equal to a very large part of the total cost of the meters.

This paper was followed by the unanimous adoption of a resolution to the effect that the sense of the meeting was that the only fair method of selling water, for both supplier and consumer, is by meter measurement, and that there should be a minimum charge for metered water yearly.

Committee Reports.

A special committee to memorialize Congress for national legislation to protect water supplies from sewage pollution was appointed eight years ago. Its Secretary, Mr. C. Monjean, of Middletown, O., stated that press of construction work during the first six years prevented him from doing much for the committee, but that more had been done in the past two years. Literature on stream pollution had been circulated, letters written and interviews held. The secretary had also prepared a report of a hundred or more typewritten pages, a portion only of which was read, although a whole evening session was devoted to it. The report, so far as read, expounded in great detail the importance of preventing stream pollution and the fallacy of the old and now well-exploded theory of the self-purification of streams.

A communication from Prof. A. R. Leeds was read, stating that the committee on animal and vegetable growths had no further report to make, and asking that it be discharged. The request was granted. The committee on pipe coating had no report to make, but was continued. The committee on law suits was discontinued on recommendation of Mr. Peter Milne, who stated that the committee's work of collecting data had been simplified by subscribing for certain legal reports. Mr. Milne stated that he had not prepared a pamphlet digest of legal decisions this year, owing to the meagerness of the matter in hand, and requested permission to defer publication until next year. The request was granted.

"The Economic Arrangement of Substructures in Streets."

By H. C. Hodgkins, Syracuse, N. Y.

The great number of conduits beneath our street surfaces, and the frequent disturbance of the latter to gain access to this underground furniture, suggests the desirability of placing all pipes and wires in an underground passage easy of access at all times. The plan most frequently proposed is a central tunnel, with the sewer at the bottom and other conduits above it. Two serious objections to this plan are the necessity of making the bottom of the subway conform to the grades of the sewer, and the fact that the streets must still be torn up for lateral connections. In place of the central subway, the author suggested two, one on each side of the street, directly beneath the sidewalk. They would have vertical walls and the sidewalk would form the roof, being carried on girders. Large sewers and large water mains would still be placed in the center of the street, for economy of space and also of grades, in the case of sewers. Sewers up to 2 ft. in diameter would go in the bottom of the subways, with frequent discharge into the main central sewer. Where possible water mains would come next, with space enough between them and the sewers to make house sewer connections. Above the water mains would be first gas pipes, then electric wires. Valves would be placed in chambers at street intersections, and all hydrant drips would be drained to the sewers. Ventilation should be provided by means of flues or pipes running up the sides of buildings, or otherwise. While such a subway system would cost more than one central subway, the expense would not be doubled. The saving in the cost of house connections to sewers, gas, water and electric mains would be great. Besides this, the problem of securing pure water would be simplified, as small pipes for potable and culinary water service could be placed in the subways. The use of water for these purposes is not over 1% of the total consumption. Why purify 100 gallons of water when only one gallon is needed? The cost of the subways would be met by rentals from companies, and from city departments using them.

There was no discussion on this paper.

"Comments on Decisions of the Illinois Supreme Court on the Contracts of the Danville and Rogers Park Water Companies."

By H. A. Keeler, Chicago.

This was a volunteer paper reviewing two State Supreme Court decisions to the effect that the city of Danville may establish fire hydrant rentals, and the city of Chicago (which now includes Rogers Park) may fix private water rates, notwithstanding the fact that these rates were named in the respective contracts. The court held that the legislative act under which these contracts were made authorized municipalities to contract for a water supply, but did not authorize them to fix the rates for a long term of years in advance, 30 years in the Danville case. These rates, the court held, must be adjusted from time to time, or they might become unreasonable and burdensome, with improvements in methods of supplying water. In 1891 the legislature authorized municipalities to regulate water rates charged by private companies, but

the two companies named held that their contracts protect them from such regulation until they expire. Mr. Dow R. Gwinn said that the city council of Quincy had passed an ordinance reducing the hydrant rental paid to his company, and that the latter had submitted to it.

"The Practical Value of Bacteriological Examinations."

By Prof. A. M. Bliele, Columbus, O.

Typhoid fever and cholera are the two diseases most commonly considered as water borne, but in addition germs causing pin worms, lock jaw, anthrax, blood poisoning, cholera infantum and diarrhoea may be conveyed by water. It was formerly hoped that specific germs could be isolated from water, but this is beset with so many difficulties that it is generally impracticable to make anything but numerical determinations. These are invaluable in connection with filtration. Besides counts of total numbers, it is advisable to determine the number of different species, as the more there are of these the more likely is it that there are numerous sources of pollution. Individual water bacteria may multiply, but species do not. Foecal bacteria, like the coli communis, denote pollution from sewage or from manured fields. Disease germs multiply readily in milk, but not in water. How many bacteria are permissible in potable water? Different authorities place the number all the way from 50 to 1,000, but the latter is too high. The safe limit varies with local conditions. Percentages of bacteria removed may be very misleading. In conclusion, bacterial, chemical and engineering work must go on together. There was no discussion on this paper.

A number of papers on the program were not read, as follows: "Good, Pure and Wholesome Water," and "Measurement of Turbidity in Water," by Prof. W. P. Mason, Troy, N. Y.; "Some Hints as to the Management of Water-Works Owned by the City," by Dr. C. F. Ulrich, of Wheeling, W. Va.; "Valuation of Water-Works Property," by John W. Hill, M. Am. Soc. C. E., of Cincinnati; "Wooden Conduits," by C. P. Allen, of Denver; and "Method Used in Repairing a 30-in. Cast-Iron Water Main," by D. W. French, of Hoboken. All but the last two papers were sent in by the authors, and will be printed in the official proceedings of the convention.

Since the report of this meeting was written a copy of Prof. Mason's paper above referred to has been received. The paper shows how indefinite such a phrase as "good, pure, wholesome water" may appear in a court room, and contains the following attempt at a general definition:

> The writer, while on the witness stand, has given substantially the following answer to the question: "What do you mean by a good and wholesome water?" "Such a water should be suited to all forms of domestic use; it should possess no objectionable taste or smell; it should be free from animal, especially human, refuse material; it should be free from vegetable material in a state of active decomposition, distinction being made between such material and those stable extractive matters often found dissolved in brown or peaty waters, and which experience has shown are not prejudicial to health; finally, it should be free from such amount of suspended material of whatever character as would make it unsightly in appearance and unsuited to the ordinary industrial interests of a community."

We have likewise received a copy of Mr. John W. Hill's paper, the title of which he changed to "Construing Certain Clauses in Municipal Franchises." The clauses discussed are those relating to the method of determining the price to be paid for water, gas or similar plants in case a city is to buy out a company. Where both parties agreed at the outset that in case of purchase nothing should be paid by the city for the franchise, Mr. Hill would interpret the language as meaning just what it says, and as excluding valuation based on the net earnings of the company. Where there is no such clause, he believes that franchise or net earning values should be taken into account.

Business and Pleasure.

During the convention a variety of business was transacted, the most important of which was as follows: The secretary reported a net gain of three in membership during the year, there being at the opening of the convention two honorary, 288 active and 68 associate members. During the convention 16 new active and two associate members were elected, but the real gain for 1899-1900 cannot be known until the year passes and the number of losses by death and resignation are determined.

The report of the treasurer showed a balance of $1,498, again $1,511 a year ago. The total receipts for the year were $1,506.

There was a spirited but good-natured contest over the presidency for the ensuing year, Mr. R. M. Clayton, City Engineer of Atlanta, Ga., finally receiving 50 votes, against 27 for Mr. Wm. R. Hill, M. Am. Soc. C. E., Chief Engineer of the Syracuse water-works. Mr. Hill was subsequently re-elected as first vice-preisdent, the other four vice-presidents being Messrs. John B. Heim, Madison, Wis.; E. Mather, Harrisburg, Pa.; C. H. Campbell, Charlotte, N. C.; and W. M. Molis, Muscatine, Ia. Mr. Peter Milne, Assoc. Am. Soc. C. E., 12 John St., New York, was re-elected secretary, there being no opposing candidate. The new finance committee is as follows: Messrs. Dow R. Gwinn, Quincy, Ill.; W. H. Laing, Racine, Wis.; A. Tucker, Memphis, Tenn.

It was voted to take steps to incorporate the association under the laws of New Jersey.

Two cities were proposed as places for holding the next annual convention, Richmond and Cincinnati. Richmond was chosen.

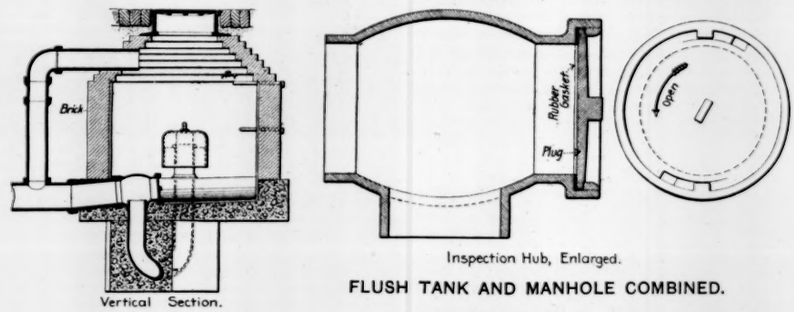
A list of the exhibits by associate members is given in the supplement to this issue.

During the convention there were visits to various points of interest, including the foundry of the Ohio Pipe Co., the roof garden of the Great Southern Hotel, Minerva Park and Casino, an exhibit of fire streams thrown by steamers from a fire cistern, and the grounds and buildings of the University of Ohio.

A COMBINED FLUSH TANK AND MANHOLE.

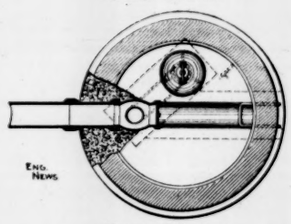
A combination of a manhole and flush tank in one chamber has been included in the sewerage system of Newport News, and in some other systems for which Mr. Alex. Potter, Assoc. M. Am. Soc. C. E., has been, or is, engineer. The idea was suggested by Mr. Wm. Mackintosh, of Mr. Potter's staff. We are indebted to Mr. Potter for bringing the device to our attention, and for the tracing from which the accompanying illustration was prepared.

As will be seen from the illustration, a lid, or plug, inserted in the end of a special, is provided for draining the chamber when it is desired to use it as a manhole. Room for removing the plug is secured by placing the long leg of the syphon to one side of the chamber. The extra expense involved in the adoption of this device is so very small as to require very little advantage in return to justify the outlay.



Vertical Section. Inspection Hub, Enlarged.

FLUSH TANK AND MANHOLE COMBINED.



Horizontal Section.

FOURTH ANNUAL CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION.

The annual meeting of this flourishing association, which was held last week in Pittsburg, was largely attended and very successful. The total number registered in attendance was over 500. The first session, on Tuesday morning, was opened with brief addresses by Mr. Wm. Yagle, President of the Pittsburg Foundrymen's Association; Hon. W. J. Diehl, Mayor of Pittsburg; Clarence Burleigh, Esq., late City Attorney of Pittsburg; John Bindley, President of the Pittsburg Chamber of Commerce, and Mr. C. S. Bell, the President of the Association. A cablegram was read from the German Foundrymen's Association congratulating the American Association upon the inauguration of its fourth annual meeting, and it was voted to make suitable acknowledgment.

The Secretary of the Association, Mr. John A. Penton, of Detroit, then read his annual report, which showed a membership in the Association of over 300. The National Founders' Association was organized as a result of the Detroit meeting of the American Association in 1897 for the especial purpose of negotiating with the labor organizations in the foundry trade, with a view to the prevention of strikes and other labor troubles. The success which it has attained is a matter upon which the American Association may well congratulate itself.

Standardizing the Testing of Cast Iron.

The report of the Committee on Standardizing Tests of Cast Iron was read by its Chairman, Dr. Richard G. G. Moldenke, of the McConway & Torley Co., and was without doubt the most important report presented to the Convention. As our readers will recall, we have already presented in Engineering News some of the results already reached by the Committee. The present report is merely a preliminary one, but it is of interest as showing the lines on which the Committee is at work and the aims which it has in view. We print it, somewhat condensed, as follows:

Your Committee herewith presents a report of the progress made during the past year in standardizing the testing of cast iron:

To standardize the testing of cast iron it is first of all necessary to know how cast iron behaves under conditions which can be readily duplicated in any foundry at any time. This brings us at once to the question of what cast iron is, and takes into consideration the chemical side of the problem. Remembering that iron contains a minimum to a maximum of silicon, manganese, phosphorus, sulphur and carbons, in proportions which almost defy classification, it will be understood that one standard test bar will exhibit all kinds of probable and improbable properties, giving little to go on except for the particular combination for which it happens to be suitable. We therefore concluded that whatever series of tests were made, they would have to be repeated systematically to a greater or less extent upon the various commercial grades of castings.

The 12 grades selected are as follows: Ingot mold iron; dynamo frame iron; light machinery iron; heavy machinery iron; cylinder iron; stove plate; gun metal chilled roll; sand roll; car wheel; novelty iron, and sash weights. Of these there are full sets of tests of some grades and only partial sets of others, the work being too large to go into refinements of some classes of iron which from their very nature can be used in but one or two ways.

We can report the completion of the first three sets of tests, and the fact that two or more are under way at the present time. A number of additional studies are contemplated, of which the first, on the transverse test, has been completed, and several more are under way. The magnitude of the work will be better understood when it is stated that so far there have been cast 667 test bars, furnishing 943 test pieces, 456 of which were machined, the total number of tests made being 1,015, and the aggregate weight of the material handled having been 12,270 lbs.

The next question which arose was: "Given the various kinds of irons, to what tests shall they be subjected to get tangible results as a basis for our study?" This was settled as follows:

(1) The tensile test up to the limits of the testing machine and its clamping devices; that is, up to 4 sq. in. sections.

(2) The transverse test also up to the limits of the testing machine; that is, with 12-in. supports, the cross-section to be up to 16 sq. ins.

(3) The compression test on ½-in. cubes, thus allowing the smallest bars to be compared with similar portions of the larger ones.

(4) A chemical anaylsis of the 1-in. square dry sand bar to get an idea of the material dealt with. It is well understood that the effects of segregation (which includes the formation of graphite) will give an interesting series of chemical studies when applied to the range of test bars contemplated. These effects, however, are the direct result of the casting temperature and the rate of cooling due to size of bar and composition of melt, and while important in their bearing upon the strength of the bars under test, are rather of a scientific interest, and hence left for future investigation.

(5) It is regretted that no machinery is available for reliable impact tests, your Committee deeming this method of testing a most important one, the only one in fact giving a true insight into the resistance of cast iron to shock. The future will doubtless bring this test forward more prominently, but whether in time for our work or not cannot yet be said. A test for hardness might also be a desirable one, and several excellent methods have been brought forward. It will be applied locally, however, each shop selecting the method best adapted to test its own work. The hardness test was therefore omitted from our list with some reluctance. A mere glance at the fractures of the bars tested will show that from the central portion outward the hardness is a regularly increasing quantity which reaches its maximum in the skin of the casting. A range of tests for hardness from center to edge might therefore be very interesting scientifically, but will hardly be essential in the drawing up of specifications. The same holds true for the shearing, punching, and hammer test for cast iron.

(6) A test for fluidity in the shape of a very long, narrow wedge, one face of it to be against a chill, the observation to be the manner of filling this out.

(7) A test for chilling quality on the part of the metal, the fracture of the test blocks to be photographed for record.

(8) A test for contraction. This is to be made by means of small depressions in the mold exactly 12 ins. apart, a suitable instrument being provided for the purpose.

(9) Finally, if time and facilities permit, some investigations, are to be made on the cooling curves of these irons, using a mirror reflection of the movements and bromide paper with the recording apparatus. The microscope, it is hoped, may also reveal something of the ultimate structure of the irons thus studied.

In addition to the above rather comprehensive programme, a few extra studies have become necessary in order to get some information on the testing methods themselves. Thus a series of tensile tests will be made on a number of bars varying only in their length and cast

under exactly the same conditions, in order to supplement the regular results so far obtained. For this work we are indebted to the courtesy of the Pennsylvania Railroad Co., Mr. Casanave having kindly authorized the various departments interested to co-operate with your Committee in the interest of the trade.

Next comes a study of the transverse test, a number of casts of bars of uniform shape and dimensions being tested with their supports a variable distance apart. These castings were kindly donated by the Frank-Kneeland Machine Co., and the tests are completed and tabulated.

The European method of making test bars comes in for some study. Mr. West has made a set of bars which will be split longitudinally to get comparative figures from the upper and lower portions, this work, by the way, being nearly complete, and another series of these European tests, as well as a set of tests on cylinder coupons, are on the programme of our Pennsylvania R. R. friends.

In arranging for the regular series of tests, the following comparisons were kept in view:

(a) Differences due to the shape of the cross-section of the bars; that is, round and square test bars compared. For each size, therefore, the areas of cross-section were made equal as the tables already published will show.

(b) Differences due to the dimensions of the cross-sections of the bars. Thus the square bars ran ½-in., 1 in., 1½ ins., 2 ins., 2½ ins., 3 ins., 3½ ins. and 4 ins., and the round bars were equal in number.

(c) Differences due to the condition of the test bars; that is, whether rough or machined. In this line of work the machinery was made rather heavier than is usual for testing purposes, and hence the delicacy of the test is somewhat impaired. Still, in practice machined castings usually have much more than the mere skin taken off, hence a true comparison of machined work with rough is better exemplified in our test where ¼-in. was taken off all around from the square bars and a corresponding amount from the round ones. In this way the rough bars were cut down to the next size below, and thus a 2-in. rough bar can be compared with a 2-in. machined one, the latter being originally a 2¼-in. rough bar.

(d) Differences due to molds; that is, green sand castings and dry sand.

The success or failure of the whole work will naturally depend upon whether the results are comparable or not, and the getting up of specifications to accomplish this gave us much concern. The final outcome of a number of plans was drawn up upon the following basis:

In a full set of bars, half are to be in green sand and half in dry sand, or cores, as the facilities of the donors allow it. Again, of all these bars half are to be tested rough and half after machining. The transverse bars to embrace all the sizes made, and the tensile to run no heavier than the 2-in. square and a round bar of equal cross-section. Since the tensile bars are of a different shape than the transverse, and the lowest number of tests for a comparison must be two, each separate pattern had to furnish eight castings; that is, four in dry sand and four in green, of which two each were machined. With 24 patterns this meant 192 bars, not counting the chill pieces and fluidity strips, and as it was decided that these bars must be cast at one time and in a vertical position to get comparable results, the outcome was somewhat problematical. To Mr. Thos. D. West, of your Committee, was allotted the task of planning the molding and casting the first set. This he did with complete success, and the thanks of the foundry trade are due to him for his disinterested work. We have next to record the generosity of the Westinghouse Electric & Manufacturing Co., who, with commendable promptness, gave us two complete sets of bars, the work being carried out by their Messrs. McDonald and Fuller. The remaining sets of bars, some of which are only partial ones, have all been promised, and we hope that the very desirable activity at present the rule in all our foundries may not retard the getting out of this work.

In connection with our work there is to be recorded the formation of an "American Section" of the International Society for testing materials. The American end of the great work mapped out has been entered with every promise of incalculable benefits to our growing export trade. Our association is now officially a member, and has a good individual representation besides, one of the elective offices falling to a member of your Committee. The recommendation to make the study of testing methods for cast iron a separate one in the international programme was adopted unanimously, and doubtless more of this will be heard in Paris next year.

The results of our investigations are hardly in shape for an extended discussion at this juncture, and hence there remain only a few concluding remarks.

That consumers of castings propose to test the work they get, is a fact patent to all who are in touch with the great interests in the trade. What shape this inspection will take is closely watched by the producer, who is naturally not very anxious to assist the average consumer in this matter. In some branches of the trade the consumer knows practically nothing of the nature of the material he buys, and it may be added that some producers know very little more. In other directions this is altogether different, and the producer is burdened with a lot of specifications which he knows amount to very little in giving what is really wanted. The founder does not as a rule object to the presence of an inspector, nor to rigid rules which he must follow, for he can make his price sufficiently high to cover this form of annoyance, or refuse to bid on the job. But the founder does object to be told that he must do so and so and then be held responsible if the results fail to come up to the expectations of those who drew up the specifications. So that after all the problem will be taken up by two classes. The Government and others who do work with little regard to expense will always specify how its work is to be cast, and will have an inspector to watch the work. It has time enough, and pays for what it requires. In the general trade, however, dollars and cents and time count heavily. Only with very heavy orders will it pay to send an inspector, for the great bulk of orders are the small ones often repeated. Taking one of a hundred castings and breaking it gives only an idea as to what that particular casting is, for in a carload of castings of the same kind there may be included the work of a number of molders and a dozen heats. Thus, after all, the real criterion of the product will be the test bars. The larger foundries, having their laboratories and test rooms, will be able to open their books for the inspection of authorized persons, and possibly send along additional test bars with their shipments, and afford facilities to their customers to see that their iron is good and their castings get a fair show. The smaller foundries will simply furnish test bars upon request and the buyers will test and analyze them themselves. There will be recognized standards for the composition required in the various classes of castings, and similarly standards for their strength.

To select, then, the form of test bar and method of test best suited for each case is the work which your Committee hopes to accomplish after the results of all the comparative tests now making have been exhaustively studied.

Respectively submitted,

Richard Moldenke, Chairman; Thos. D. West, Jas. S. Stirling, Jos. S. Seaman, Jos. S. McDonald.

The reading of this report concluded the morning session, and the remainder of the time until luncheon was spent in examining the various exhibits. The most notable of these were the specimens of fractured bars of different sizes tested by the committee whose report is presented above. The effect of the thickness of the casting upon the structure of the metal was shown in a remarkable manner, the small castings ½-in. square showing a grain almost as fine as tool steel, while the large castings of 3 and 4 ins. thickness showed a very coarse crystalline structure.

Second only to this exhibit in interest was a remarkable collection of art castings in iron, owned by Mr. John A. Penton, of Detroit, the Secretary of the Association. They were chiefly of Russian and German production, and were wonderful examples of delicate and difficult foundry work. Many were reproductions of famous vases, statuettes and other objects of art in European capitals. The collection is owned by Mr. Penton and Mr. Russell, of Detroit, and is probably the finest set of art castings in iron that exists in this country.

Besides this collection, some very creditable examples of art castings were shown by the Yale & Towne Co., the Magee Furnace Co., the Michigan Stove Co., F. L. Kahn & Bros., of Hamilton, O., and the Smith-Anthony Co., of Boston. Some name-plates cast by the Westinghouse Electric Co. were also exceedingly creditable examples of sharp castings, in sections quite difficult to make.

Mr. S. H. Stupakoff, of the Union Switch & Signal Co., showed a choice collection of specimens of ores and minerals. The General Chemical Co., of Pittsburg, had samples of fluor-spar for foundrymen's use. The Pennsylvania Car Wheel Mfg. Co., showed samples of street car wheels and specimens from wheels broken under a drop. Mr. H. S. Vrooman, Chicago, Ill., had a full-size arch made with his patented dovetailed fire-brick, illustrated and described in our issue of March 16, 1899. Other exhibitors were the Carborundum Co., of Niagara Falls; the J. D. Smith Foundry Supply Co., of Cincinnati; the H. C. Frick Coke Co., and the Keystone Bridge Works.

Tuesday afternoon was devoted to an excursion by trolley to Schenley and Highland Parks. At the former place an hour was spent in visiting the beautiful Carnegie Music Hall, Library and Art gallery, and at Highland Park the visitors were taken to the Zoological exhibit, and were under shelter there during the heavy wind and rainstorm which swept over the city during the afternoon.

The evening session was notable for the presentation of two admirable papers describing modern stove foundry plants, the first by Mr. A. W. Walker, of the Walker-Pratt Mfg. Co., whose new works are located near Boston, and the second by Mr. W. J. Keep, of the Michigan Stove Co., Detroit, Mich. Both papers were illustrated by stereopticon views, and the former included a large number of views of notable buildings in Boston and vicinity as well. The Walker works are an example of advanced ideas in modern foundry design. All the buildings are of one story, and the use of labor-saving appliances and conveniences and comforts for the workmen has been carried out to a remarkable degree.

Standardized Drillings for Iron and Steel Analysis.

The first business at Wednesday morning's session was the report of the committee appointed a year ago to bring about the preparation and distribution of standardized drillings for the use of chemists engaged in iron and steel analysis. We quote from the report of the committee as follows:

Standardized drillings are especially prepared and carefully analyzed samples of iron by which the chemist can test the accuracy of his work. The only way a chemist can know the correctness of his results or give others assurance that his work is right is by having them checked or by analyzing drillings that have been determined by competing chemists, to find whether results agree. The latter process is, in a sense, a method of checking similar to the use of standard weights to test the accuracy of scales.

The necessity for a laboratory having something in the way of standardized drillings has led many heretofore to make their own, after the following plan: The chemist, having decided upon the grade of iron thought best for the work, sought out a piece of clean pig metal of such grade, and drilled it until he had obtained from eight to twleve pounds of drillings. These would be well mixed and in some cases ground in a mortar. This done, he would put up packages of a few ounces each and mail them to other chemists with a request that they anayize them for metalloids for which he wished to obtain standards. When the different results had been reported, he would accept the average as his standard for the drillings in his possession.

These standardized drillings could then be reanalyzed at any time to check the chemist's own or others' work.

The process by which the individual chemists obtained their own standards was, as a rule, long and tedious. It often took from four to six months to get in all the results. Then again, as a rule, the results varied so much that the average accepted would at times seem more like guess work than anything coming from accurate work and methods. The variation in analyses thus obtained have often caused great differences in standards in use in different circles and perplex managers of furnaces, steel works, foundries and chemists, rather than help to correct evils and prevent losses.

It was the opportunity of observing the practice of blast furnace chemists in obtaining their standards which led to the idea of one central agency from which all could obtain standardized drillings which had been determined by a few of our best known chemists.

Our committee secured the able services of Prof. C. H. Benjamin to supervise the work of making drillings from cylindrical castings, and that of Prof. A. W. Smith (both of Case School of Applied Science), to carry forward the work of preparing, standardizing and packing the samples. We were also fortunate to secure and combine the services of Messrs. Booth, Garrett & Blair, Andrew S. McCreath, Cremer & Bicknell and Prof. A. W. Smith to analyze the drillings, the average of which results were accepted as standards.

The Committee then described the method used to obtain a sufficient quantity of clean and perfectly homogeneous drillings. A mold was made for a hollow cylinder to be cast on end and fed by both top and bottom gates. An overflow vent was provided through which surplus metal could escape. After the mold was full the pouring was continued, with the result that 300 to 500 lbs. of metal escaped through the overflow and the whole body of metal left in the mold was thoroughly mixed, and all slag, scum and dirt escaped through the overflow.

When the casting was completed, it was placed in a lathe and the outer ¼-in. was turned off and removed. The turning then continued until only about ¼-in. in thickness of the inner shell remained, and these turnings were carefully saved. It should be added that in the turning, ½-in. at the bottom and 2 ins. at the top of the cylinder were omitted.

The turnings thus obtained were passed through 20 and 40-mesh sieves and were then thoroughly mixed. Bottles holding ½-lb. each were then filled, precautions being continued to make the mixture placed in each bottle absolutely uniform.

Three castings were treated in this way, to give three kinds of standard drillings. The first was high in the four metalloids, silicon, sulphur, manganese and phosphorus. The second had a medium amount of them, and the third was low in them all.

The following gives the analysis of these samples, being the average results obtained by the chemists named above:

Sample.	B.	C.	D.
Silicon	1.076	1.783	2.921
Manganese	0.415	0.442	0.971
Sulphur (grav.)	0.056	0.076	0.031
Sulphur (vol.)	0.038	0.059	0.024
Phosphorus	0.092	0.272	0.890
Titanium	0.056	0.060	0.071

A sample was also analyzed for its carbon, graphite and combined carbon contents.

The Committee further stated that it had offered the set of three bottles for sale at $5, and up to May 7 had supplied them to 83 laboratories, including those of 31 blast furnaces, 14 steel works, 14 engineering schools, 13 private laboratories and 11 foundries.

A vote of thanks was awarded the Committee, and they were instructed to continue and enlarge the field of their work by consulting with a committee of the American Chemical Society, with a view to the adoption of standard methods for iron and steel analysis.

The History and Technics of Bronze Founding.

This paper, by Mr. Jas. Powell, of Cincinnati, was largely historic, or, rather, prehistoric, in its character, dealing with the earliest knowledge of the art of founding alloys of copper. The author said that the bronze of the ancients was remarkable for its uniform composition. It seldom varied from 10 to 12 parts tin to 88 or 90 parts of copper. The so-called "tempered copper" of that time was a myth, the hardness being the result of the addition of the tin, with sometimes an accidental small quantity of iron. By heating their cutting implements to a dull red and plunging into water, with subsequent hammering, a degree of hardness and toughness could be attained sufficient for their purposes, and which would produce a very efficient tool.

The following description of the process used by the Greeks and Etruscans in casting bronze statuary is of interest:

The figure of the desired casting is first roughly modeled in clay, but slightly smaller than the future bronze. Over this the sculptor models a skin of wax to the desired form and finish. A mixture of clay and sand wash is successively painted with a brush over the wax, until all the lines and depressions are filled up. A compound of soft clay and sand is then thickly laid over, until sufficiently strong, with the aid of iron hoops to hold it all together. The mass is slowly dried and placed in a hot oven and thoroughly baked, the melted wax escaping through an opening made for the purpose. The space left by the wax is the intended thickness of the casting. The molten bronze is then poured in until the mold is full, the core being held in place by small bronze anchors running through mold and core. After cooling, the outer shell is broken away and the core dug out through a hole left in the base or foot of the piece. If the modeling is skillfully performed, there is very little to do except scraping or sandpapering. This process cannot be much improved upon even to-day, and has been used up to the present time.

Importance of Fillets and Round Corners on Modern Machinery Castings.

This paper, by Mr. John M. Richardson, dealt with a subject of great interest to every machine designer and draftsman. We condense it as follows:

Take some machine tool casting made 25 to 40 years ago, and compare it with one of the same class brought out at the present time by any up-to-date concern, and what is the first point of contrast noted? You will all an-

swer, "The design." Wherein is this difference of design? It is to a great extent in the large and smoothly-rounded curves and heavy fillets everywhere present in its outline.

Sharp angles, fancy moldings, panels, etc., look very nicely on doors, store counters and a great many kinds of furniture, but are decidedly out of place and likewise impracticable for cast iron. I consider it of great importance to have a machine casting designed so that its exterior will present as smooth a surface as possible, and all angles and recesses of any kind provided with good liberal fillets.

A drawing where this matter has received attention presents a much more finished appearance, and reflects credit on the designer, for it shows that he looked ahead as far as the foundry.

In the pattern department fillets serve a very important purpose. A fillet is actually a pattern strengthener, aside from its foundry value, provided it is composed of a substance having some tenacity in itself, and aside from this property, it is very often a time-saver also in the work of the pattern-maker.

Wood, leather, lead, beeswax and putty comprise the kinds of fillets ordinarily used, and they each have their appropriate place, except the metallic one. Lead has no affinity whatever for glue; so the only thing that can be employed to fasten it is shellac or nails.

Probably the finest fillet of all is made of wood, worked out of the solid pattern, having no feather edges whatever, but this is a very expensive kind, and can only be used on the finest jobs, so in every-day practice we have to add the fillet to the pattern as a separate part.

For fillets from 1-in. radius down to ⅛-in., leather is unquestionably the best and most practical material that can be used, and when properly applied will not peel up even with the hardest usage, and requires no nailing whatever, glue being the only agent employed. Those who condemn the leather fillet for patterns, probably do not understand the proper method of applying it. There is a sort of trick about it, to be sure, the keynote to success being hot water. Cover the back of fillet with thick glue, and place it quickly on the pattern, instantly drawing a round-ended slicking tool of proper radius along its surface, bearing down hard to exude any superfluous glue, and following this with a woolen cloth wet in very hot water, to remove all pressed out by the slicker. Repeat this until not a particle of glue squeezes by the edge of the fillet, then wipe with a dry cloth.

Where it is hard to bind the leather neatly around small curves, etc., immerse it for an instant in hot water. This renders it perfectly pliable, but it means quick work, for the thin edges will shrivel and harden at once if not immediately placed in position and burnished down as previously described. A leather fillet put on properly, with strong glue, can only be removed when dry by great force, and will then come off with fibers of the wood adhering to it. Light patterns are strengthened by them to such an extent that nails are frequently unnecessary.

Beeswax is all right for very small fillets, for finishing out where leather ones come together at the top edge of a rib, when the curve is very small, and for many other places. The wax is prepared by being put in a cylinder, having holes of varying diameter in one end. This is warmed and the wax forced through with a plunger, and then applied with a warm slicking tool of the right radius.

If used too cold the fillet will not adhere firmly to the wood. In fact, it is hard to lay wax fillets satisfactorily in a cold room, for both pattern and wax are chilled to commence with, and the heated iron, bearing on the top surface of the fillet only, makes it difficult to communicate the heat evenly enough through the whole mass to secure a firm contact with the wood, and after the pattern has seen constant use in the foundry, the wax will peel up badly. Wax is not a durable substance for fillets if sunshine or heat of any kind strikes it to any extent.

Putty has always been used in great quantities in pattern making, and probably always will be, on account of its cheapness. Undoubtedly more feet of fillet can be applied in a given time with this substance, for a given amount, taking both the material and labor into consideration, than with anything else, but it is only adapted to cheap work, and not for standard patterns, as it is soft, easily dented, marred or bruised, besides imparting no element of strength whatever to the work. Plaster of paris is sometimes added to it, to increase its durability, but when this is done, it must be used immediately after mixing.

Black putty is nothing but common putty mixed with lampblack, and is employed only on cheap work, having but one coat of shellac, this being applied after the sandpapering, thus comparing in color with the blacking on the pattern, and saving a second coat.

When fillets are called for having a radius above 1-in. they must be worked out of wood, and this should be done after gluing to the pattern, not before, in order to have the feather edge adhere as firmly to the work as possible. It is almost impossible not to have the edge curl away if cut out first, and then fastened to the pattern, even if the precaution is taken to have the angle of the fillet made slightly greater than that of the corner it fits, in order to cause a binding of the edges.

A mold of any considerable size can be made more safely, quickly and easily and with a minimum of labor, where these points have been considered in the design, and carefully followed out in the pattern, and with far more chances for a perfect casting, as the danger of cracks in shrinking have been eliminated. How many castings are spoiled by having some slender part joined to a heavier one, with no fillet where they come together, thus causing a crack by the shrinkage strain at the junction, it would be hard to determine.

A pattern heavily rounded wherever possible will certainly leave the sand very much more easily and with less danger of breaking the mold, thus saving labor in patching and mending.

I would go so far as to say that every edge of a pattern, except on surfaces to be machined later, should be rounded, even if the radius of curvature is so small on some light work, that it can be done entirely with sandpaper. On brackets, ribs, heading, etc., it is much more satisfactory when one gets accustomed to it to have the edges terminate in a semi-circular section, rather than flat with the two corners somewhat rounded.

The author objected to the practice of requiring the molder to cut fillets in the sand, instead of placing fillets on the pattern. It is often difficult for the molder to do this, and when he attempts it the result is often an imperfect casting. In conclusion, he pointed out that a casting well filleted is more easily cleaned in the pickling baths and by the cold chisel, and is more easily machined, as there are no sharp interior corners for the sand to stick in.

In the discussion on this paper, the advantages of fillets were still further brought out. With reference to their value in relieving shrinkage strains in castings, it was pointed out that in the steel foundry large fillets were now known to be essential to success.

This paper concluded the session of Wednesday morning. In the afternoon the members were carried by a special train on the Pennsylvania Railroad to Wilmerding and East Pittsburg, where the great shops of the Westinghouse Air Brake Co., the Westinghouse Machine Co. and the Westinghouse Electrical Co. were visited. At the first named place, the traveling conveyers, which carry the flasks to a point convenient for placing the cores, clamping and pouring, and the molding machines were a revelation in rapid working to many of the visiting foundrymen. At the Westinghouse Machine Works were seen a 300-HP. three-cylinder gas engine in operation on the testing floor, and in the main power station of the Westinghouse Co., a similar engine was driving a direct-connected dynamo, and running as steadily as a steam engine. The shops of the Electric Co. were crowded with work, in all departments. A large addition to the main building of the electric works is erected, and is now being covered, while ground has been broken for a large addition to the works of the machine company.

The return to Pittsburg was made in a heavy rainstorm, which continued during the evening and considerably reduced the number taking part in the principal social event of the convention, the reception and musical entertainment at the Hotel Schenley.

The concluding session of the convention opened on Thursday morning with a paper by Mr. Albert W. Smith on "The Utility of Chemically Standardized Iron Samples." The paper was more largely devoted, however, to an explanation of the value of chemical analysis as an aid to the furnaceman and the foundryman, and a plea for careful and accurate analyses and the paying of such salaries as would enable competent chemists to be employed for the work. The following extract is of interest:

At some works the practice exists of keeping record of the total expense of maintaining the laboratory, and this sum total is divided by the whole number of analyses made during this time, the quotient, or cost per determination, being apparently taken as an index of the efficiency of the laboratory! An equally sensible analogy would be to value the services of one physician by the average cost per pill administered, regardless of results. I am informed that in some cases this efficiency index has been squeezed down as low as fifteen cents. A chemist in such employ, recognizing the fact that he must keep this cost per determination low to please his superiors, exerts himself to the utmost to swell the number of analyses made, and, no doubt, grinds them out as best he can under such influences, but with how much regard for accuracy and real value to practical application. I wish also to say that there are many laboratories which are not influenced by this expensive fallacy, and where accuracy is the first requirement. In all such places the cost per determination may be very high, but the actual value to the company is correspondingly large, and costly controversies over disputed results are rare or unknown.

Advantages of a Foundry for Light Castings on an Upper Floor.

In this paper Mr. C. J. Wolff described a foundry in which all the molding is done and the castings are poured on the third floor. This floor has wooden joists covered with 3-in. matched-plank, and on this is laid 4-in. cedar blocks. The molding sand covers this, and is sufficiently damp to form a protection against fire. Around the cupolas the floor is of steel beams, with brick arches, and the whole covered with cinder concrete. The cupolas rest on brick foundations, built up from the ground. This arrangement has given excellent satisfaction, and the insurance rate is said to be no higher than for foundries on the ground floor. The advantages enumerated are the great economy in ground covered, the protection against obnoxious and intrusive visitors, the inconvenience for the men to leave their work readily, and also the means afforded for better light and air.

A paper on "The Construction of Brass Melting Furnaces," by M. E. Millett, of the Millett Core Oven Co., Springfield, Mass., was the next paper on the list. It described a recently patented brass furnace, in which the holes for the crucibles are built up of I-beams and masonry, and all ranged alongside of the central flue.

The Deceptive Fracture of Pig Iron.

The concluding paper of the session was by Mr. Thos. D. West, of Sharpsville, Pa., and set forth the reasons why the old method of judging the quality of pig iron by the appearance of the fracture is being discarded by every intelligent furnaceman and foundryman. We quote from the paper as follows:

Progressive furnacemen and foundrymen have experienced few changes in their practice that have been more radical in character or far-reaching in benefit than those made by the adoption of chemical analysis to correctly define the grade of pig iron. When we recall the time that all furnacemen and founders were guided wholly by the appearance of fractures, instead of by the chemical analysis of their pig iron, we naturally have a right to wonder how they ever succeeded in business, and not until we bring to mind the old-time prices paid for castings can we realize why commercial success was at all possible to many following the old school methods of judging the grade of pig iron.

While the benefits obtained by adopting chemical analysis in foundry practice are generally very great, the advance has been slow. This is on account of the prejudice, selfishness and conservatism that all new departures in any calling must meet and set aside.

There are several ways in which self-interest can retard the progress of chemical analysis in founding. As an example, we will cite two cases. The first lies in the power of furnacemen, knowing the utility of chemical analysis and lack of that knowledge by the old-school foundrymen. To illustrate how the latter may be duped by making them think their practice correct: A well-known firm, standing high in its ability to cast heavy machinery, recently sent an order to a furnaceman for one car of a strictly all open-grade iron to make strong castings for a special job. The writer was consulted as to the analysis necessary, as the furnaceman knew he could select the open iron in almost any grade. Upon learning the character of the casting required for the furnaceman, the writer recommended silicon between 1.00 and 1.25, with sulphur about .030. A car of as beautiful open-grained coke iron as was ever seen was sent to the founder. Its results pleased him so much that in a few weeks the second order, "Send me another car of strictly No. 1 iron, same as last," came in. The furnaceman, knowing the utility of chemical analyses, referred to his books and duplicated his last analyses, being careful, of course, to load nothing but an all No. 1 open-grained iron, as, if he had sent a close-grained iron, it would have been condemned. Now, this furnaceman is not going out of his way to advocate the utility of chemical analyses to that foundryman, and it would be almost useless for anyone else to attempt to do so, as that founder is stubborn in the belief that it is the open-grained iron of that peculiar brand which was wholly responsible for obtaining the results desired. Then again, should this founder change to another furnaceman, on account of a difference in price, who might not have had the forethought to consult some expert of the new school in regard to analyses, the chances are that his open-grained iron would have given him too weak a result in his castings; but as long as this founder had his open-grained iron, he could turn to changes in the fuel, scrap irons, blast, weather, methods of changing, etc., to make excuses for his ill results, and not until such a paper as this, exposing the true cause of his trouble, might by chance fall into his hands, is there any hope of his being made a follower of the new school practice.

The foundation of the old-school method in regulating mixtures is based on the belief that the appearance of pig fractures truly defines the character of iron as to the degree of hardness. The founder's own experience in knowing that he can make soft and hard castings from the same ladle and at one pouring, if he choose to so construct his molds, should be sufficient to prove to him why it is possible for two furnace casts of pig metal that are alike in chemical analysis, or will give the same results when melted, to differ so widely in appearance that the fracture from the one cast will seem close-grained or hard in the pig, while the other will be the reverse. A founder can take the same ladle of iron, and by pouring part of the metal into a mold that will chill or solidify it quickly, produce a fracture that will be close-grained in the one case and open in the other. This is just what the furnaceman does in making pig iron. One part of his tap, or cast of iron, may run so slowly from his furnace as to chill the metal before it reaches the pig beds, while another tap or cast may come so fast as to fill the pig beds so rapidly that it will take quite a while for the metal to solidify.

Again, one tap or cast at a furnace may give much hotter iron than another, and it is natural that the dull iron should cool faster than the hot, and, if both run at the same speed from the furnace down the long runners to the pig beds, will give the closer grained iron in the case of the duller metal. Surely the founder should perceive from this why the same kind of iron may have in one cast a close grain, and in another an open grain. As there are but few molders or founders who have ever had the opportunity of witnessing a furnace cast, this explanation of its workings, combined with their own foundry experience, should assist many to realize why the fracture of pig metal is an unreliable guide to the iron's true grade.

An able discussion of the above paper was presented by Mr. Paul Kreuzpointner, of Altoona. He said that cast-iron is a fluid mixture of several different ingredients, which crystallize on cooling. The size of these crystals and consequently the appearance of the fractured surface depends upon the length of time in which cooling takes place. To illustrate this, he said that soft steel ordinarily cools with crystals of microscopic size, perhaps 1-400-in. in length. He had seen, however, soft steel escape through the bottom of a furnace, where it cooled exceedingly slowly, and under these conditions a crystal of steel had formed 1⅝ ins. long and ⅝-in. wide. Besides this, it must be remembered that cast-iron, like other minerals, is subject to segregation during the process of cooling. This is especially true in the case of cast-iron which is high in the metalloids, and such metal should not be kept hot and fluid too long.

This concluded the technical work of the convention, and the society then proceeded to the election of officers. A previously appointed nominating committee presented its report, which was ratified, and the names of the new officers are as follows: President, J. S. Seaman, Pittsburg; Secretary, John A. Penton, Detroit; Treasurer, Howard Evans, Philadelphia; Vice-Presidents, A. W. Walker, Boston; Dr. R. J. Moldenke, Pittsburg; J. P. Golden, Columbus, Ga.; C. A. Bauer, Springfield, Ill.; W. A. Jones, Chicago; W. S. Mozier, Dallas, Tex.; Joseph Best, Montreal, P. Q.

After resolutions of thanks for the various courtesies and hospitalities which the visitors had enjoyed, the final adjournment was taken. In the afternoon the final excursion on the program took place. A half-dozen electric cars carried the party up the Monongahela valley to the famous Homestead works of the Carnegie Steel Co., and an hour was spent in catching a glimpse—it could not be more in the brief time allotted—of this enormous establishment and the industries which are carried on within its bounds. Afterward the cars were again taken and the party was carried to a pleasure resort in a beautiful grove on the line of the Pittsburg & McKeesport Electric Ry. Here was spread a luncheon for the delectation of those who were hungry and thirsty. This, with an informal "smoker" in the evening at the Monongehela House, concluded the set festivities of the convention.